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ABSTRACT

The special problems faced by black, Mexican-American, Appalachian, and ethnic white minorities in college education, particularly in chemistry, are examined in the papers contained in this conference report. The most important problems for all groups are deficiencies in verbal and written English, mathematics, general science, and intellectual background. Such students typically lack self confidence, and many expect to fail in college. Obstacles to higher education include college selection procedures, competitive pressures, faculty attitudes, teaching styles, and examinations and grading practices. Suggestions for minimizing these disadvantages include the use of clearly stated behavioral objectives, the use of supportive remedial programs in English and mathematics, and the use of broader liberal education programs. Descriptions of innovative chemistry instruction for underprepared students in ten colleges are summarized in the report. Five specific recommendations summarizing the conclusions reached are appended. (AL)

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CHEMICAL EDUCATION
FOR UNDERPREPARED STUDENTS

A Report of a Conference
Held at the University of Illinois at Chicago Circle

Compiled by Robert I. Walter

January, 1971

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The conference on "Chemical Education for Underprepared Students" was held in Hull House on the campus of the University of Illinois at Chicago Circle on 10-12 September, 1970, immediately prior to the 160th meeting of the Americal Chemical Society. Some of the points of view expressed at the conference were presented by a panel of conferees to a session of the Division of Chemical Education on 16 September. This report contains detailed summaries of the background statements made to the conference, together with shorter summaries of some programs in chemistry designed to meet the needs of underprepared students. Financial support for the conference was provided jointly by the Committee on Educational Aid of the E. I. du Pont de Nemours Company and by the Office of Undergraduate Education in Science of the National Science Foundation. The conference was organized and chaired by Professor Robert I. Walter of the University of Illinois at Chicago Circle, and this report was written by him.

Readers who are interested in a permanent information exchange for communication of ideas on chemical education for underprepared students should send an expression of their interest together with their suggestions on the operation of the exchange to the author of this report.

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SUMMARY

This report describes the proceedings of a conference on chemical education for underprepared students which explicitly considered special problems in education of the black, Mexican-American, white ethnic, and Appalachian minorities. No one was present with significant experience in teaching Puerto Ricans or Indians, and there was essentially no discussion of them.

There is a tendency for each minority group to view its own problems as unique. The striking fact which emerged from conference discussions of deficiencies in these groups was the number of problems common to all of them, independent of racial or ethnic origin. The most important and widespread of these are deficiencies in verbal and written English, in mathematics, in general science, and in stimulating intellectual background which might contribute to learning in any area. Apart from these basic academic problems, these students are so seriously lacking in self-confidence that they avoid science courses and many of them *expect* to fail in college. The results of this unfavorable self-image are displayed in various ways: unwillingness to try difficult tasks, unwillingness to seek help, or in a tendency to give up too easily on difficult work. In these non-academic respects, there may be some characteristic differences between students from different racial or ethnic backgrounds. Faculty members who hope to cope successfully with these problems will need to examine themselves, their programs, and their institutions much more searchingly than has been customary in the past. They will also need to be exceptionally open to new ideas.

The obstacles to higher education for these students may be magnified by some largely unexamined characteristics of the conventional educational environment: its selection procedures, the competitive pressures under which students work, and faculty teaching styles and attitudes toward students. The standard examinations used to predict student performance display no demonstrated racial bias, but there are serious questions about their value in predicting the performance of underprepared students in more suitable academic environments *which provide special supportive services* for these students. The preparation and use of behavioral objectives was described, together with their advantages in defining a course, in writing reasonable examinations, in simplifying the logistics of multi-section courses, and in improving student performance. The conferees then heard detailed descriptions of supportive programs in remedial English and remedial mathematics, and of broader programs designed to embark disadvantaged students on a liberal education. All of these matters are unfamiliar to most chemists, so they are reported here in some detail. There followed descriptions of a variety of innovations in chemistry instruction for underprepared students in some ten institutions which range from liberal arts colleges to large urban universities; these are summarized briefly in this report.

INTRODUCTION

The conference on chemical education for underprepared students was concerned with problems of chemical education for students who lack the qualifications for college work conventionally evaluated by measurement of academic achievement. "Conventional" chemical education (that is, an undergraduate curriculum designed more or less along the lines suggested by the requirements for departmental approval of the A. C. S. Committee on Professional Training) is a demonstrated success with *well-prepared and highly-motivated students.* Increasing numbers of contemporary students are not well prepared in any conventional sense, although many display good intellectual capabilities. These students, and perhaps students more generally, tend not to be highly motivated today. They are suspicious of science, tend to be afraid of science courses, and generally display a contempt for the deferred gratification which has been the operational basis for successful pursuit of demanding undergraduate curricula. From the students' standpoint, the standard chemistry curriculum (and particularly the introductory course) is a Procrustean bed which they must fit, regardless of background or interests. This was not such a severe limitation when the students admitted to college-level institutions were a rather homogeneous group with middle-class backgrounds or aspirations to join the middle class. For the most part they could fit this program. If not, there was no evidence that their failure was due to an obvious mismatch between their backgrounds and those assumed in the design of their courses. Most of the educationally-deprived students with whom we are concerned come from backgrounds which deviate so far from these assumptions that their failure is virtually guaranteed.

College admission criteria have traditionally relied heavily upon standardized tests (e.g., those given by the Educational Testing Service or the American College Testing Service) and upon high school class rank. Cutoff scores for college admission of course vary widely with the institution involved. The most highly selective institutions accept few students whose SAT scores in either English or mathematics are below 650, while some institutions set no minimum test scores at all. Leadership in higher education traditionally has been exercised by those institutions with the highest admission standards. Other institutions often try to follow the educational patterns set by the leaders, even though their student bodies may be much less homogeneous and usually include many students who cannot begin college work at this level or pace. The participants in this conference represented institutions which have not been considered among the leaders in American education, but which are faced with the largest numbers of students with deficient backgrounds and which have the greatest experience in dealing with these students.

In most institutions the introductory chemistry course is largely a service operation, but it often is designed and taught as if it were intended only for chemistry majors. Very few students are converted into chemistry majors by their exposure to the course. Intelligent and well-intentioned faculty members are undisturbed by a failure rate which ranges from twenty to fifty percent. In fact, the high rate of failure and the recognition of the introductory chemistry course as the device which sorts out apparently unpromising students has tended to be a point of pride in many chemistry departments. The time for change in such attitudes is long past. None of these criticisms of current practice in the freshman course implies a need to change the level of achievement required to complete the full major program in chemistry. They do imply a need for a change in the level and pace of beginning courses from which only a small fraction of all students eventually enter that major. Furthermore, attention to these problems might suggest ways to eliminate some of the loud complaints students now voice over the major program itself.

What justification can one offer for attention to the problems of underprepared students at the present time? The major factor is the rising educational expectations of our population. A larger fraction of all segments of the population now hope to attend college, and if possible to earn a degree. This is true even among minority groups which have not previously attended college in large numbers: blacks, Mexican-Americans, Puerto Ricans, or Indians. It is equally true among disadvantaged groups of the white majority: urban ethnic groups and Appalachian residents. Present trends in education lead one to expect that educational expectations will continue to rise. For example, the recent report entitled "The Open Door Colleges"* recommends that financial support be provided to insure free access to education through grade fourteen for any member of the population who desires it. (This does not imply that every individual needs or wants education to this level, but that it should be available to him if he does.) If all segments of the population avail themselves equally of this opportunity, the number of students through at least the first two years of college will continue to rise dramatically, and the increase will be greatest for members of minority groups. Provision for universal education through high school in this country has been accompanied by a serious decline in standards and expectations of performance in many high schools; the quality of these institutions now varies widely. *Will free access to education through the first two years of college also be attended by a severe decline in the quality of the education received? Will academic chemists face these educational problems, or will they continue to ignore them and leave them by default to others who are not qualified chemists?*

Several types of institutions are affected by current attempts to meet the educational needs of underprepared students. Many of the most selective institutions in the country now have special programs for high risk students. In practice this usually means only black students, and it would seem worthwhile to recruit additional students from other minorities or from the white majority who are equally high risk in order to avoid giving the false impression that underprepared students belong only to one race. The problem of education for underprepared students also arises in institutions which have lower admission standards, ranging downwards to completely open admissions. These include most urban universities, most junior colleges, and many of the developing four-year colleges, including most of the predominantly black colleges.

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*"The Open Door Colleges," a special report and recommendations by the Carnegie Commission on Higher Education; McGraw-Hill Book Company, Hightstown, N. J. 08520, June, 1970.

Invitations to attend this conference were intended to include a reasonable cross section of those institutions which offer programs for underprepared students. Inevitably there are many such programs on which we had no information or which are operating this year for the first time. For example, the chemistry department at the College of the Pacific this year is including six graduates of predominantly black colleges in a program designed to reinforce subject matter background in chemistry, to consider explicitly problems in recognizing and dealing with the disadvantaged, and to culminate in the M.A. degree.

The conference met in Hull House on the campus of the University of Illinois at Chicago Circle. Mr. James C. Griggs, Jr., Director of the Educational Assistance Program on the UICC campus, welcomed participants to the conference and gave a brief description of the EAP program, which recruits and encourages minority-group students to study at the college level. EAP operates with a relatively small staff which includes academic and personal advisors. These advisors are selected for their experience in counseling and their knowledge of the young blacks who make up the great majority of students in the program. EAP personnel have obtained some changes in institutional practices in order better to accommodate their students. Decisions on expulsion for academic reasons are now deferred until the student has been on campus for a full year. Innovations include more individualized instruction as a replacement for massive courses in which the student is lost in an impersonal crowd. Unfortunately, the EAP program has not been very successful in interesting students in the professions, particularly the sciences or medicine.

The titles of this conference and of this report both include the adjective "underprepared." The majority of conferees felt that this and similar euphemisms: remedial, compensatory, and so on, must be avoided in discussion of these programs in public or with the students who might enter them. These students already suffer so many academic and psychological or emotional handicaps that labels of this type simply reinforce their feelings of inferiority and their expectation that they cannot manage a college program. For these reasons it appears necessary to use public labels for these programs which do not include these negative connotations.

There was disagreement on whether certain specific courses or programs should be labeled remedial, quite apart from the effect of this label on students. One source of the disagreement was failure to agree upon a definition of remedial programs. Most participants in the conference would label as remedial any program specifically designed for students who must begin their college work at a level substantially below the norm for beginning college students. The level of the work done, then, specifies that label. By this criterion, almost all entering students in some institutions would be classified as remedial students simply on the basis of the level of beginning courses. Other conferees maintained that any program designed for students who meet the normal selection criteria for a particular college is not remedial, and furthermore maintained that use of the term remedial (in addition to the adverse effect of this term or its synonyms on the students) adversely affects the subconscious attitudes of faculty members who teach such courses. It lowers their expectations of the students, decreases their willingness to work with them to achieve a reasonable level of performance, and is seen by the students as a decreased willingness of the professor to accept or like the students he teaches.

This disagreement on course labels implies disagreement on the best means to succeed in the education of underprepared students through the college level. The approach which has received the most attention is to provide some type of remedial or compensatory program designed to upgrade disadvantaged students within a relatively short time period to the point where they can move into the conventional educational program. This is the basis of most of the programs described in this report. Most of them assume that more than the conventional four years will be required to earn a baccalaureate degree. Those who follow the remedial approach operate on an implicit assumption that the disadvantaged student is a temporary problem. They expect that improvements in high school programs and in the home environments from which these students come will gradually eliminate the need for special attention to them at the college level.

A second approach questions the entire concept of remedial education. Advocates of this position point to the failure of the educational system to meet the needs of disadvantaged students during their twelve years of grammar and high school. They feel that a remedial program implies a continuation of educational efforts of the type which already have failed these students who differ in cultural background, life style, and perceptions from the middle class majority. These differences in student background require a substantial permanent change in educational strategies, and Leroy Colquitt has spoken to this point in his paper on the program of the Institute for Services to Education which begins on page 43.

There also was disagreement about the relative place of undergraduate teaching and of graduate teaching and research in the universities. Opinions here covered the full range of those which have been expressed elsewhere. Some participants held that some ongoing scholarly work, which might or might not take the form of research, is necessary to maintain awareness of field and teaching effectiveness through a professor's lifetime. Other participants maintained that an overemphasis on research and the devotion of disproportionate support in both faculty manpower and funds to instruction of the small numbers of students at the graduate level was the chief cause of the neglect of undergraduate instruction which now prevails. There was agreement on the need to reorder university priorities so that time, financial support, and prestige reward those faculty members who contribute to progress in this area.

Various opinions were expressed about the educational promise of students, and probably most active teachers have experienced failures with at least some of the students they encounter. This is partly a question of level: all students should be able to learn something about a subject, but probably only a few are capable of mastering it to the high level demanded of professionals. On the other hand, some conferees referred to published examples which illustrate the possibility (and the confidence of modern educational psychologists) that *anyone can be educated to any predetermined level if sufficient resources are expended for that purpose.* It will often be necessary to employ quite unconventional methods to accomplish this goal. Contract teaching arrangements in which commercial organizations have agreed to teach reading in the elementary schools on a performance fee basis were referred to as examples. Clearly, the methods used in experiments of this sort are worth more attention than they have yet received from scientists in education. It is also clear that the examples which have been quoted to prove universal teachability all involve learning at levels which correspond to the early grades, and not at the college level.

Descriptions of individual programs required much more of the three-day meeting than scheduled for them, so the conference gave little time to careful examination of gaps in our information or to preparation of recommendations for future action. Both for these reasons and because no one present had final answers to any of his problems, the results of the conference cannot be regarded as definitive. The general consensus of the conference on desirable features of programs for underprepared students is summarized in the recommendations at the end of this report.

It was apparent that many of the conferees have been struggling in isolation with problems in the education of underprepared students. The conference provided a significant psychological lift to members who thus learned that others face similar problems, as well as a useful exchange of specific ideas and methods. We hope that this report will make these benefits available to a wider audience of those who are struggling with these problems which have recently grown to major social and moral concern to the nation.

FACTORS WHICH INFLUENCE THE EFFECTIVE EDUCATION OF BLACK STUDENTS

Leroy Colquitt, Thomas Parmeter, and Samuel von Winbush

Some impression of the backgrounds of students in the predominantly black colleges can be obtained from statistics which have been gathered in connection with the program of the Institute for Services to Education. In the colleges connected with that program, about one-third of all entering freshman come from families with incomes below $3000 a year. Two-thirds of the freshmen come from homes with an annual income below $5200, and less than seven percent of these students come from homes with incomes above $10,000. In contrast, for the entire population $10,500 is the median income base for families of students attending institutions of higher education, and less than fourteen percent of all students come from families with incomes below $5200.

Most of the parents of these students have very limited educational backgrounds and are employed as non-professionals. Thirty percent of the fathers have a grade school education or less, fifty percent of the parents have less than a high school education, and less than ten percent of the parents are college graduates. About forty percent of the mothers of these students are employed as domestics, and the same fraction of the fathers are employed as unskilled or semi-skilled laborers. Only fourteen percent of the parents of these students are employed as professionals. In the past the only two professions readily available to blacks were education and the ministry, so the great majority of the professional parents are engaged in these professions. About half of the students come from very poor rural areas, and nearly half come from cities that range from small towns to the ghetto areas of very large cities. But in contrast to higher education generally, there is an unusual concentration of students from a rural agrarian background.

Educational backgrounds of entering students vary considerably with the institution involved. On the average, the mean entering test scores of LSE students are one standard deviation below the national norms. Average verbal ability scores are below the 40th percentile for the norm group, and the norm group is based on individuals age 17 and over which include a large number who will never attend college. Put another way, these students test approximately four grade levels below the national average in English language skills. Only non-verbal ability scores approximate the national norms.

There are other factors of a cultural nature which are difficult to evaluate statistically but appear to have important effects on the behavior of these students. The education of their fathers is generally inferior to that of the mothers. Thirty percent of the students come from homes in which there was only a mother, while an additional ten percent were raised by grandparents or other relatives. There are twice as many professionals among the mothers as among the fathers. The ratio of entering males to females is the reverse of the national average: about forty percent, as compared to sixty percent for all population groups. The average male student scores better on entrance examinations and other ability tests than the average female student, but the attrition rate is higher and the average achievement rate lower for the males. Evaluations of personality valuing preferences reveal something of a reversal of the normal white male-female norms. Black male students score much higher on values like support and benevolence, and the females score higher on values such as independence and leadership. Probably these data for one group of southeastern predominantly black colleges are more extreme than would be observed among the black students in northern urban universities. However, one could expect that black students, irrespective of location, would be closer to these data than to the norms for entering white students.

The history of the predominantly black colleges, which are small and poorly endowed and thus should be least able to deal with the heavy educational burden imposed by the heterogeneity of their students shows that they have been most effective in educating them competently. They have graduated about 75 percent of the black baccalaureates and from them have come most of the black scholars in this country: 74 percent of all black Ph.D's, and 83 percent of the black M. D.'s. These institutions have performed very effectively with student bodies whose entering test scores average a full standard deviation below the national norms. They have demonstrated that it is possible to get students from such backgrounds through college in a four-year period without the mechanism of remediation. They have learned to deal with the specific problems of these students in the context of a college curriculum, and from a positive point of view which does not assume that it is up to the entering student to conform to some arbitrary set of expectations. Nor does this assume at the outset that students cannot make it or that only certain career avenues are open to them. The search for black identity, the increased value given to poetry, to art, and to music in the black community today, and the whole effort to create a new level of self-awareness in terms of the black experience are producing a unique intellectual format. This intellectual involvement and experience are also reflected in the development of black identity for a minority submerged in a white racist culture.

If educators will look dispassionately at the successes achieved in the predominantly black institutions they will find that there is much to learn from their experience. These institutions must be given the kind of support they need to deal effectively with the problems that have been assigned them for the past hundred years. They have the experience and have demonstrated their effectiveness in dealing with these problems. They achieve their success by asking basic questions about the intent of efforts at remedial education and the limitations that it imposes. The answers must be translated into the larger educational context in order to meet the kinds of challenges that are being posed to higher education today by the demands for greater accessibility to higher education.

One hears occasional demands for the teaching of black chemistry and black medicine. Possibly more of these demands originate with those outside rather than those within the sciences. It is probable that the answers will be found not in terms of special chemical information which should be available to blacks only, but rather in an understanding of the social-political implications of the uses of science in society and how science may be employed to serve blacks. On another level, if more black students are to be motivated to study science, they must be encouraged by positive images. Consequently, there is a need to recognize the historical roots of science and mathematics in black cultures and the contributions of black people to the development of the subject.

It is desirable for the highly selective, usually well endowed and predominantly white educational institutions to admit a larger number of high risk black students. However, it should be recognized that these students will need special attention and relevant curriculum materials that make sense in terms of the expectations of the world of work and their past experience. Faculty members in colleges and universities of this type generally have low teaching loads, so it is possible for them to devote the necessary time to developing good teaching strategies. The faculty must recognize the importance of empathy with these students. They must make it clear that they like and accept them, and they must project their willingness to work with them to attain their expectations. Furthermore, these institutions are relatively strong financially, and can afford to make special efforts in creating effective educational practices. In addition, the prestigeous white institutions ought to recognize the expertise that predominantly black institutions have developed in effective educational practices and draw heavily on that expertise as they move towards increasing the numbers of black students on their campuses.

ACADEMIC PROBLEMS OF MEXICAN-AMERICAN STUDENTS

Jared B. Sharon

East Los Angeles College is a two-year institution with an enrollment of 14,000 students, some 40 percent of whom are Mexican-Americans. Probably this is the largest enrollment of Mexican-American students in the northern hemisphere with the exception of the University of Mexico in Mexico City. Mexican-Americans who live in the United States call themselves chicanos; they usually have only five to ten percent Spanish blood. A typical chicano feels that while his parents are Mexicans, he is neither a Mexican with residence, citizenship and voting rights in that country, nor an American, since he doesn't look like an anglo. There is very little contact between the chicano and Puerto Rican communities, and members of the latter group are largely of Spanish extraction.

Despite the fact that our Mexican-American students perform as well on the average on placement examinations as do our anglo students, the former group has a lower percentage who register for science courses, including chemistry, and a higher percentage who register but drop out after starting the course. Only a very low fraction earn the higher grades awarded in these courses; the average performance of those few chicano students who survive the course is significantly lower than that of the anglo students. It appears that young chicanos tend to avoid higher education, and if they do undertake any education at that level they tend to avoid courses in science. One possible reason for this is that most of them arrive in college with backgrounds which lead their advisors to recommend a lengthy series of remedial courses in order to remove deficiencies before beginning the college level science work; this is a discouraging entry to any major.

A number of factors applicable to science courses have been identified which appear to affect the performance of the chicano student adversely. These are (with wide individual variations through the group):

1. inadequate mathematics background, frequently indicated by a low score on the Toledo placement examination.

2. no high school chemistry course or else a course taken at certain feeder high schools whose graduates have not been successful college students through the years.

3. a tendency to prefer artistic rather than quantitative expression.

4. registration in chemistry under parental pressure rather than as a personal goal.

5. a tendency to pursue short-term material goals rather than long-range planning with deferred gratification.

6. severe lack of self-confidence.

7. inability to comprehend adequately the nuances of spoken English.

8. repulsion by apparently cold instructors who convey a highly impersonal subject matter.

These traits are similar to those exhibited by most dropouts; the difference lies in the emotional depth of the negative self-image held by most chicanos. These students often do not believe that they belong in a chemistry course and exhibit from the beginning an attitude which is both cavalier and defeatist.

Our data indicate that academic background deficiencies alone do not fully account for the inferior performance of Spanish surname students who complete a chemistry course. I have identified the following underlying causes for these background deficiencies of chicano students registered for science courses. Many of the problems are fundamental to all academic areas and tend to diminish the students' success in other courses also. Many of these factors apply to all students from deprived socio-economic groups:

1. inordinate anxiety about tests, rooted both in a negative self-image but also in inadequate preparation.

2. a necessity for outside employment.

3. a crowded, noisy home environment in which the student must study.

4. bad study habits and inability to concentrate.

5. boredom with repetitious drill on routine, seemingly irrelevant topics.

6. inability to grasp the subtleties of written English or to extract salient points from outside reading assignments.

7. absence of earlier experience with which to associate chemical principles.

8. a frequently inordinate tendency to retain an erroneous method for solving a problem.

9. a tendency to emphasize memorization of theoretical principles while avoiding mathematical solutions to problems.

10. a tendency to be non-competitive and resistant to time pressures, and therefore unwilling to take examinations.

There is considerable overlap between this list and sociological factors which have been suggested by various authors to explain the avoidance of education and poor academic performance of young people from backgrounds which are characterized by socio-economic deprivation. These are summarized very briefly as: lack of a home tradition which supports effort devoted to formal education; a lack of parental guidance in long range planning aimed toward higher education; a limited childhood exposure to stimulating toys, books, or cultural events; competition of part- or full-time employment for study time; a home environment which militates against development of intellectual discipline and concentration; a lack of constructive peer group influence; and culturally biased counseling which tends to recommend against setting high personal goals. In addition, there are four factors which apply uniquely to the students of chicano background: a strong negative self-image which tends to be rather emotional; teachers who hold low expectations for these students, reflected in advice against a major in science; a serious lack of role models because there are very few chicano teachers; and finally the unique communication difficulties which arise from the fact that many of these individuals speak neither Spanish nor English adequately, but use a virtually unintelligible combination of the two languages. These factors lead to a low self-esteem which has been demonstrated not to be connected with lack of motivation or desire for education. These students from poor socio-economic backgrounds want to learn, but their negative self-image interferes seriously with their ability to do well in conventional settings for formal education.

This handicap is reinforced by lack of acceptable role models (there are very few Mexican-American teachers), by the negative counseling they receive and by the language barrier. The language problem not only imposes a communications barrier, but the effort to change a child's language (this is commonly done with Spanish-speaking children in southwestern schools) gives him the impression that his cultural heritage is insignificant. The language problem in that sense is less important than the negative self-image the child acquires. It isn't until eighth grade discussions of the American melting-pot that a student is brought into contact with other races and their contributions to the development of the United States. A young chicano has difficulty identifying with the melting pot.

A number of steps can be proposed which should help to minimize these deficiencies. There is great need for bilingual instruction. Probably this is most urgent in the elementary grades, but it would still be useful even at the college level to improve communication and relieve student anxiety. Some of the pressures associated with unfavorable environmental conditions could be minimized by greater involvement of the college in current and proposed community uplift schemes. Some of the mismatch between inferior secondary school education and college level courses could be removed by coordinating the training of science teachers for the secondary schools and colleges. Explicit attention should be given to some of these problems during the preparation of teachers. For example, in the Los Angeles area most teachers would benefit from some time spent in practice teaching in schools with Mexican-American student bodies. In the college-level institutions, it would be useful to use an ABCW grading system which would permit an indefinite number of repeats so that students could take their own time to remove deficiencies before proceeding to more advanced courses. These and other minority group students need special tutoring and group counseling services. Faculty understanding could be improved drastically by better acquaintance with the chicano community and understanding of its values. Fewer students would be repelled by an image of cold impersonal science if greater attention were paid to the selection of teachers with warm outgoing personalities. And finally a wide variety of mechanical teaching aids should be made available for student selection and use as they prove beneficial; an emphasis on audio-visual techniques would transcend some of the language barriers faced by these students.

Many of these problems may be unique to the chicano in California. For example, the border area in Texas was essentially unsettled until fairly recently, when it was populated by immigrants from Mexico. These people were never a cultural minority, and their use of political power to help solve problems is growing very rapidly.

A Comparison of the Problems of Chicano and Black Students

In a sense, to ask whether black or chicano students are worse off is like worrying about who is in ninth or tenth place in the Pacific Coast League. Conditions are not good for either group, and many factors which affect them adversely operate for both groups. There are, however, some significant differences. The first of these is language. In the Los Angeles area, chicano students are four years behind anglos and two years behind blacks at the beginning college level in their tested reading ability. This makes a profound difference in performance at the college level, for these students have barely made it through a minimal high school program during the years when they should have been accumulating the background for successful work in college.

Black Americans speak an English dialect, but at least it is based on English, even though many words used by southern blacks derive from West African languages. But a chicano child doesn't speak English at all. California schools do not recognize that the child is foreign to English, and then help him make the transition by beginning instruction in Spanish with a subsequent gradual change to English. Instead, he is classified as a slow learner and held at one grade level until he drops out. The language barrier also explains why it would not be enough to apply solutions proposed for the black community to the chicano students. Busing would not improve their schooling: students would still fail to understand English in a different school. The real problem is to improve the quality of education wherever the students are, and to recognize their basic difficulties with the change in language imposed by the school system. Language continues to be a problem for chicano students even at the beginning college level. It is the basic cause of their failure to acquire an adequate academic background, and furthermore students at the college level still have trouble reading laboratory instructions with perception or in following lectures. This is the incentive for taping lectures for this audience so they can be heard repeatedly, or for providing programmed instruction based on simplified English.

There are significant differences in the cultural backgrounds of blacks and chicanos. The latter are neither Mexicans nor are they Americans, while the blacks are a subculture within the dominant white American culture. Chicanos come from homes with strong religious orientation and rather authoritarian parents. These factors tend to suppress curiosity and critical thinking and reduce interest in the sciences. Family ties appear to be much stronger in the chicano community. Students are intensely aware of the economic needs of their family, they feel a strong obligation to contribute to the family income by holding jobs, and consequently the unemployment rate among chicano teenagers is approximately sixteen percent compared to forty-two percent among blacks in Los Angeles. Furthermore, although the gross family income averages $6700 annually for chicano families and only $5700 for blacks, the per capita income is significantly lower due to the larger size of the Mexican-American families: $1380 per capita per year compared to $2100 for blacks. Young men of Mexican-American extraction are affected by the group of values which make up the spirit of machismo. This requires them to contribute to family income, and leads them to accept and retain employment even at menial and very low-paying jobs and at the expense of their academic work. It also inhibits young men from admitting and facing the consequences of their academic problems: often they will simply withdraw from school rather than admit they are doing badly and seek solutions to their problems. In the Los Angeles area, the level of average formal education for parents of college students is significantly higher for blacks (at 12 years average formal education) than for chicanos (at 8.7 years formal education). Others have spoken of the matriarchal society in which blacks grow up; in our area, a woman is the major source of family income in twenty-seven percent of Mexican-American homes, but in forty-three percent of the homes of black students.

This discussion of the characteristics of Mexican-American students was followed by a slide presentation by Mr. Frank Gutierrez. He gave an impressionistic view of the chicano community in East Los Angeles: its environment, its sources of income, some cultural values, and economic and population pressures which face it.

TEACHING PROBLEMS IN AN ETHNICALLY-MIXED URBAN TWO-YEAR COLLEGE

Louis J. Kotnik

Cuyahoga College was named from the county and local river, and their name in turn comes from an Indian word meaning crooked. Both the river and the county are very crooked. The institution operates on an open door admission policy: the only requirement is a high school diploma or its equivalent. Our students range in age from sixteen to sixty, and we find the oldest ones easiest to teach. They have in mind a definite purpose for which they are studying, and they are willing to invest the effort necessary to make good. We have both terminal and two-year transfer students. The range of their preparation is very wide. Some are well prepared and come to us because the institution costs little. Others have negligible preparation for college-level science courses.

The student body of about 11,000 at the metropolitan campus is about thirty percent black, fifty percent ethnic and largely Catholic, and about ten percent Jewish. Even though the racial and ethnic backgrounds of faculty members have about the same distribution as the student body, faculty members often do not identify with their students. It is interesting that thirty years ago the ethnic whites described themselves as Poles, Slovenians, Italians, and so on, but now they use a hyphenated American name. The ethnic neighborhoods are not breaking up in Cleveland. They are simply moving as units to the suburbs, largely under pressure to escape the blacks. The problems which face our hyphenated American, black, and chicano students are very similar. The students themselves probably would deny this, but in fact they work with similar psychological handicaps and background deficiencies.

On our campus, physical science, chemistry, and physics are combined in a physical science department. We offer two years of both chemistry and physics, together with some service courses for the liberal arts program and others for various technological programs, together with some remedial courses. We do not label them remedial for two reasons: a college-level institution in the state of Ohio cannot legally teach a remedial course, and this term carries an unfavorable connotation for our students.

There are serious teaching problems on our campus. The principle ones are:

1. a tremendous range of student abilities, from very good with no psychological hangups, to very poor with all sorts of personal problems.

2. serious fear of science (this appears to be common to all minority groups).

3. fear of failure in science. This leads students to try courses in the order biology, then chemistry, then physics as classes fill and they must meet distribution requirements.

4. fear of asking for help. Our students expect to be rejected and frequently are. Many of them almost must be forced to come for help.

5. lack of empathy between the instructors and students, despite the fact that the faculty makeup approximates the ethnic backgrounds of the student body. This is even true between black instructors and black students.

We observe reasonably close correlation between test scores and performance in courses. ACT English and math and the Toledo chemistry test correlate well with performance in chemistry courses, but for some reason the ACT science score does not. Our successful experience with these tests helps us compensate for the variation in student background by assigning students to appropriate courses. Student fear of science, fear of failure, and unwillingness to ask for help are most difficult to overcome. A federally-sponsored tutoring program has been helpful, but the essential ingredient for successful teaching in our circumstances is that a sympathetic relationship be established between the instructor and his students. We have also found it useful to make available alternate teaching devices -- for example, audio tapes and single concept films -- in addition to conventional lectures, lecture notes, and an appropriate text.

The reasons for poor performance by our students are much the same, irrespective of racial or ethnic origin, as those listed by Mr. Sharon for chicano students. Among the items on his first list of factors which restrict the performance of students who withdraw from chemistry courses (page 11), numbers 1, 2, 5, 6, and 8 apply to Cuyahoga students. Items on his second list (page 12) of background factors which restrict the performance of students who do complete the course, numbers 1, 2, 3, 4, 6, 7, 8 and 10 apply to our students. I have inadequate evidence to decide on the others.

It is striking to us how similar the problems of our students are irrespective of their ethnic backgrounds. If they come from culturally poor environments, they usually display the same set of characteristics. How these will affect the student will vary with his particular ethnic or racial background, and these factors also determine the reasons he has acquired these characteristics. But the ingrained sense of inferiority and fear of failure appear in all cases. I believe that the *basic* reasons for these handicaps are the same for all groups: their families are not educationally oriented and even less oriented toward science, most of their homes contain practically no books, there is a pervasive sense of alienation from the American mainstream, and they won't take chances for fear of failure, and won't ask for help for fear of rejection.

We have found it very necessary to have a model with whom students can identify. Some time ago I asked the president of our Afro-American society to recommend a student to work as laboratory assistant. He was quite successful, and we have had a steady stream of replacements, together with a steady increase in the number of black students in chemistry courses. This may well be because they see a fellow black of about their own age and background who is successfully holding a science-based job.

We have had favorable results with laboratory experiments based upon the use of sophisticated instruments. Even though a student lacks the background to understand how the equipment operates or the theoretical description of the spectra, there is something about running an infra-red, UV, or NMR spectrometer which fascinates the student and stimulates his interest to such an extent that he may go on to learn the theory on his own. We make available extra reading material on the instruments and we find it is used extensively.

We are very much interested in offering our remedial chemistry course on a flexible time basis. We would like a student to be able to complete it in any time possible for him from four weeks to forty. The quarter system under which we operate is particularly frustrating and anxiety-producing to our students because they hardly get started before they face the threat of examinations and grades. Alternatively, we could turn to an ABCW grading system which would permit a student to repeat without discredit those courses from which he withdraws.

There is great need for improved laboratory experiments. Everyone seems to be reprinting some laboratory manual written fifty years ago: the approach is not varied and it bores the students. In my experience the most popular first year lab work is in qualitative analysis. The students enjoy the challenge of solving problems on their own, and there is enough competition between students to give the work excitement, but not enough to be self-defeating.

EDUCATION OF STUDENTS FROM APPALACHIA

Thomas R. Beebe

Appalachia is that mountain region which extends from New York State through Pennsylvania, Maryland, Virginia, and the Carolinas to Georgia and northern Alabama. I lack the benefit of birth in the Appalachian region: our family farm in southern Ohio was hilly, but not hilly enough to qualify. Berea College was founded in 1855 on the premise that labor (which was then not well thought of in the south) and the education of black and white students could be combined. By 1890, Berea College was approximately 50 percent black, but that era ended when the Kentucky legislature passed a law specifically directed against Berea which outlawed the education of blacks and whites under the same roof. The college carried a legal challenge to the Supreme Court but finally lost, and the law was not repealed until 1950. During that period the college shifted its educational emphasis to the Appalachian region, where it could continue to work with underprepared and financially handicapped students. The policy then set was to admit only those students who could not afford the cost of higher education, and this continues to this day.

Eighty percent of the current student body is from southern Appalachia, 12 percent from other sections of the United States, and the balance from foreign countries. Our total enrollment is approximately 1400 students and half of these come from homes with family incomes below the poverty level defined by the federal government. Berea College charges no tuition; students pay room, board and incidental fees which total less than $700 per year. The college has a compulsory work-study program in which all students are expected to work a minimum of 10 hours a week; students are paid regularly by check, and manage their own funds. We try to see that no student has a financial problem; for example, no student function can cost more than 25¢. We guarantee not to drop students for financial reasons while they are in college, and they can earn about two-thirds of the cost of college during the nine winter months.

The college maintains good contact with high schools in the Appalachian region but admission operates as a screening rather than a recruiting device, since we have about 1100 applications for 400 freshmen places each year. Most students admitted to Berea College have traditionally been in the high risk category. Our SAT scores average about 450 on the verbal and math tests for women, and 450 verbal and 490 on the math for men. Berea's educational scheme includes a remedial program in the sense that about half of our students take remedial work in five areas: reading, composition, geometry, algebra, and geography. Many students require five years for graduation. The need for this type of work is illustrated by the fact that many students who come to us cannot pick out Kentucky on a United States map.

We do not know how to teach chemistry to the Appalachian students with weakest backgrounds. The SAT scores of students who successfully complete chemistry majors are nearly one hundred points higher than the average scores for the entire student body. In the past ten years or so we have had only one or two Berea students who completed a chemistry major after beginning their college work with remedial mathematics. We have been severely restricted by manpower problems (a two-man departmental staff) in planning special efforts to help underprepared students in chemistry. The science departments at Berea are concerned because they do not educate a significant number of students in the high risk category. We are working on a program for training premedical students whom we then expect will return to their mountain homes to practice. It will be based upon audio-visual techniques, and will take advantage of the pool of help provided by the student labor program.

Last year we deliberately sought and admitted a larger proportion of blacks to the college, selected mostly from Alabama and north Georgia high schools. They ranked in the top ten to fifteen percent of their high school classes but in the bottom ten to fifteen percent of our entering student body. We added a black counselor and admissions officer, and a coordinator who interviewed each high risk student and matched him individually with a student tutor for each course. Those upperclassmen who have themselves been through the high risk program are anxious to help lowerclassmen, and many of them work as tutors. Black students usually have black tutors. Last year we lost twelve percent of our high risk students after one semester, and twenty percent by the end of their first year. This is rather higher than the overall college loss rate. This year we will give up the grade of F: no grade at all will appear on the transcript, and the course can be repeated for credit. Students need pass only six semester courses for the year (including the summer session), or about two-thirds of those for which they would enroll in a normal program.

There are very few black residents of the Appalachian region. Citizens of that area are almost entirely very poor white Anglo-Saxon Protestants. They have had little exposure to blacks, so their prejudices are based on inexperience. Minority group students are aware that they have an educational problem; students from Appalachia are not. They are very proud and sensitive people. In the heart of the region, they almost never reflect emotion in their faces. They do not react to stimulus, and may never have experienced happiness. Their environment is extremely poverty-stricken in terms of external stimulus. Students of this extreme type really ought to have special cultural enrichment programs before they begin college work. Many of the more aggressive people have migrated from Appalachia to the northern cities. There they tend to live in ghettos, they are disliked by their neighbors (the stereotype is dirty), and they face discrimination in jobs and education.

Some years ago our student body included twins who had never before seen a movie. Other students devoted a great deal of effort to deciding which movie they should take them to see first. However, the environmental shock was too great for them; they left the college after one semester. We do not feel that we reach this type of student successfully.

Berea students are great to work with. They have reasonably high potential, they are very acceptive, but they can easily be destroyed by a poor first impression. It is necessary to build the students up by small achievements. Of course the first year courses are most important in this operation, and we assign our best faculty to freshman courses. We have few students with very high test scores, so the entire student body is reasonably homogeneous. Both black and white students in the high risk program feel reasonably comfortable in that environment.

Discussion developed the consensus that five-year programs are acceptable under the GI bill and to draft boards if these organizations are informed that the program is designed for five years and normally completed in that interval. However, there appears to be a need for a collective statement by educational institutions to establish the legitimacy of five-year programs in the eyes of agencies of this type.

ORGANIZED EDUCATION AND THE DISADVANTAGED STUDENT

Thomas Parmeter

As college-level education has grown into a major industry, it has become increasingly organized and systematized. The organization and the system presumably offer some convenience and advantage to administrators and faculty members, but too often fail to take account of the students' developmental and educational requirements. When institutions of higher education try to cope with students from either a racial or a cultural minority, they are faced with a more heterogeneous student body than the system generally is designed to accommodate. This inflexibility, coupled with institutional vested interests and a misguided involvement in social certification, is at the root of many educational problems.

The central construct of this conference -- the "underprepared" student -- is symptomatic of both an educational failure and of institutional inability to examine the concepts underlying its operation. Classification as "underprepared" places the entire burden on the student, regardless of background or developmental status, to fit into a conceptually-limited educational scheme. The justification for this institution-oriented approach is usually based on the alleged need for the maintenance of "educational standards". In reality, both the approach and the educational "standards" are based upon entering characteristics of students which are measured against a normal distribution curve. These normative standards vary widely both between different institutions and even within certain institutions. The norms, together with the course organization, type of instruction and sequencing behind them, are the major roadblock to a more viable, individual-oriented approach to education. There are four principal reasons for this inflexibility of norm-based education:

1. Normative differences between individuals tend to be interpreted as fixed and largely predetermined.

2. Normative measurements of certain popular, but limited, educational abilities and of content acquisition-recall show a high relationship over time; this relationship is usually used to justify current educational practices. It could be interpreted more accurately as an indication of the inability of current educational practices to alter individual learning and development.

3. The use of norms as a controlling factor in the choice, organization, and presentation of educational experiences becomes increasingly invalid as the range or degree of heterogeneity increases.

4. Norms and their status implications are by nature competitive, and produce an enlargement of differences between individual evaluations of self-worth.

It would be foolish as well as inaccurate to deny that intellectual standards and accumulated knowledge are two of the principles around which higher education should be organized. It is even important to recognize the contribution of the disciplines as the moderating entities through which both the product and the process of intellect are developed. Instead, I argue that higher education currently operates at educational odds with the principle of valid intellectual standards by defining too narrowly both the content of intellect and the process of its development. A central premise to this contention is that the normative standards actually used are not directly comparable to intellectual standards, and under certain conditions operate conversely to them. In order to apply this contention to the "disadvantaged" student, I will first discuss some important assumptions about the nature of intellectual development, about the developmental characteristics of students and their relation to the nature of educational institutions, and about the minimum conditions necessary to begin to reorient institutions toward a more relevant educational program. Although part of this presentation is based upon experiment or educational theory, a great deal of its coalescence and direction is due to experience with the Thirteen College Curriculum Development Program, an experimental curricular and instructional development program cooperatively conducted by a group of predominantly black colleges and universities, and the Institute for Services to Education.

Assumptions about Human Development

There is now substantial evidence to support the position that belief in fixed individual intelligence is no longer justified. This implies that whatever might be the capabilities of students reflected by conventional testing procedures, including college entrance exams, these abilities are potentially subject to development and change. Moreover, human intellectual development is far from predetermined. The human mind does not operate like a preassembled static switchboard as in a telephone exchange. It is much closer to the active information processor programmed into an electronic computer, or more precisely, like the executive system of a computer. Human experience programs the human brain and additional experience can change the program. For example, the early development of the individual depends much less upon the response to instinctual needs and impulses than upon the opportunity to see and experience a wide variety of things. Finally, there appears to be no need to stimulate learning by unpleasant reinforcement; there is an intrinsic motivation inherent in the information processing or cognitive function itself. This suggests that learning which can be accomplished by painful stimulation is largely limited by stimulus-reinforcement. Self-generative learning on the other hand is largely a function of intrinsic motivation developed out of interaction with experience under non-punitive conditions of reinforcement. Perhaps the most notable example of this approach is to be found in the original work of Maria Montessori.

Unfortunately, many programs in higher education appear to operate on an assumption that human intelligence is fixed, and that nothing can be done to improve the "executive system" in an individual mind. The students we call disadvantaged are obliged to pursue their educations in a situation in which their inferiority is a reality of circumstance. The terms underprepared, disadvantaged, culturally deprived or whatever euphemisms are used, constantly create an aura of inferiority in these students' minds which is reinforced by painful, mindless remediation approaches to education, and by their inability to escape the lower end of a largely predetermined performance curve. No matter how good our intentions, or how great our interest, these terms and most educational programs designed to compensate for disadvantaged backgrounds continually reinforce for these students the fact that they are inferior. This negative cycle traps many students, particularly those from racial and cultural minorities, and it functions in both special educational programs and normal classroom settings. This is due both to their negative motivational characteristics, and to the nature of the largely one-track normative-competitive educational environment.

We now need to introduce an important distinction between types of human development. There are two important conceptions of human development which are never mutually exclusive in a given individual or learning opportunity. One is growth -- the normal continuum between what a person was and is and will become. Growth can be most simply described as the continued development of a given characteristic or set of characteristics, such as ability to spell. It is represented psychometrically by the high reliability of test scores taken at different points in time. A second conception of development is that of alteration, a change in the developmental pattern. Alteration is demonstrated by Piaget's theory of intellectual development as the change from reflexive to concrete cognitive operations. It is represented less clearly in a learning setting by what Bruner calls an insight, or a new way of perceiving similar stimuli. Alteration poses a basic psychometric dilemma: it is represented with very low reliability by a series of scores over time. From the psychometric standpoint low reliability is usually the sign of a poor instrument; consequently testers and test-makers largely ignore this type of development.

In a given educational setting or individual learning experience, the distinction between growth and alteration is difficult to make in terms of the actual development which takes place. However, the thrust of explicit operations of the institution can be clearly identified. Entrance exams, grades, performance exams, "studying for the test," the use of outline series or memorized notes or text summaries all relate to growth. It is a very limited form of growth at that, based primarily on information storage and recall. Furthermore, the use of these devices maintains and in many cases enlarges the entering differentials which exist between students. It would be incorrect to claim that growth is not a desirable developmental goal, or that content is not important, but the absence of alteration opportunities for the individual in conventional educational programs is a serious deficiency. In our educational system there is an interlocking network of adverse circumstances, from too few teachers to monotonous lectures; from multiple-choice, recall-type exams to negligible active participation of students in the classroom or in educational decision-making. These tend to extend the limited entering ability differences between students, and concommitantly their feelings of self-worth, without providing opportunities to make up deficits or enhance other individual characteristics.

It is much easier to criticize conventional higher education than to specify the educational procedures necessary to provide for alteration and a broader classroom experience. But it is possible to look at conventional educational practice in terms of student approaches to learning and development and the failure of the traditional settings to accommodate differences in approach.

Institutional organization leads to courses structured in both content and presentation for a hypothetical intermediate-ability student. We all recognize that there are differences in learning style and pace. For instance, there are broad differences in what we might call the human perceptual sense. In the simple area of learning to spell, there is vocal perception (spelling the way one speaks the word), there is visual perception (remembering the way the letters look), there is audio perception (remembering the way the word sounds), and finally there is a kinesthetic perception (spelling the way the word is traced). Any or all of these activities may be present in differing degrees. At a more advanced level, these differences appear as the preference of one student for learning by careful attention to a lecture, and of another student for learning by careful note taking (because he learns best from a precise listing operation). Most education is so organized that learning is a retention-retrieval operation even though we pay lip service to problem solving and discovery.

The type of cognitive structure an individual develops is highly important in determining what he can do. That structure (similar to the executive system of a computer) is largely determined by his previous experience, both direct and vicarious. Sometimes one is frustrated in an effort to teach a specific concept or set of information to a student who apparently cannot learn it. The difficulty may be that he has not developed the same basis either organizationally or definitionally for receiving or processing information as has the teacher. Furthermore, the individuals from disadvantaged backgrounds may disappoint us in their rate of learning under normative conditions. This may be because the rate of learning curve is the inverse of the rate of forgetting curve, and we must balance the gain of information against its loss. One problem in compensatory approaches in earlier education has been that when a compensatory effort is discontinued after a short period of time, the rate of loss of information under less intense conditions exceeds the rate of new learning and the program (for example Headstart) appears to fail.

The conventional organization of higher education tends to ignore all of these factors. It labels students as underprepared or disadvantaged and reinforces their own sense of inferiority. It designs a relatively rigid program for a hypothetical intermediate-ability student, and consequently bores the best and loses the slowest learners. It ignores differences in individual perception and background experience which may leave a student without any capability for understanding or retaining a particular type of information. It structures learning largely around telling students both content and process, and thus fails to allow students the opportunity to adapt individual characteristics to master materials and activities.

Competitive Pressures in the Academic Environment

The great majority of students who traditionally might be considered underprepared attempt to acquire a higher education because they recognize its practical value. They want to live in better circumstances than they have in the past, and they realize that education means a higher relative position on the social scale. Unfortunately, aspirations to social mobility are by nature competitive; they represent competition between people moving in a status system. Success in college is similar to this: it is represented by standing in class, grade point average, or various academic honors, all of which are awards for achievement in competitive activities. The institutional response to the need to referee the college intellectual competition is to set up homogeneous programs which differentiate students' standing on the basis of their positions on a series of normal performance curves. The normal performance curves are based upon performance in examinations which also are normative and from which grades are assigned on the basis of a series of cutting points. The result is that a student is not competing against a course, or against clearly announced goals which form the basis for that course. Instead he is competing against other students in terms of information measured only at an output point, and in terms of a limited set of student characteristics already clearly differentiated upon entrance.

Pressures Toward Homogeneity in the Educational Environment

Individual colleges, particularly private institutions, fit their performance curves to a limited number of characteristics of entering students. The students themselves aid the process to some degree by self-selection into an appropriate institution. This is done on the basis of their own evaluation of personal abilities and characteristics, together with information from guidance counselors, friends in college, and so on. The result is an instructional setting dominated by homogeneous programs offered to homogeneous groups of students. Both the programs and the students tend to be traditionally oriented and mutually supportive, and reluctant to consider change. This educational environment may produce student growth in those characteristics which form the foundation of the homogeneous population present, and it provides socialization and social mobility, but it does not provide for student development as individuals or for alteration of individual abilities and characteristics.

Many public universities (unlike the liberal arts colleges) on the other hand accept students over a much wider range of abilities -- usually from one standard deviation above to one standard deviation below the norm. At the same time, the faculty members tend to take a homogeneous approach to instruction, again based on a mythological intermediate-level student. The instruction offered is simply not adapted to the range of abilities present in a class. Students face additional handicaps in these large institutions. As a rule they are in classes with a relatively high ratio of students to faculty members. The discipline-oriented faculty and the departmental structure tend to make curriculum revisions relatively easy within departments (if they can overcome tradition) but quite difficult across department lines. Finally, the status pressures in these institutions tend to produce a research-oriented faculty with limited interest in undergraduate teaching or innovation in it.

We must face the fact that too few students are reached by current educational methods. The teaching system is designed more for the convenience of the educators than for the benefit of the students it serves. It tends to focus blame for its failures on the students, rather than on the system itself. Finally, it is supported by strong vested interests which are resistant to change. (Some of the resistance originates with students themselves, who cannot perceive alternate ways to do things.) It appears unlikely that the system will change of itself. In its present form it is incapable of meeting the needs of society, and some means must be provided to force changes in it.

Very little of this discussion has been directed toward disadvantaged students, per se. It has been based on the assumption that so-called disadvantaged students are those who fall at the lower tail of the curve of entering abilities. For historical as well as environmental and background reasons, this lower tail usually includes a large number of students from cultural and racial minorities. This fact simply adds urgency from a sense of social justice to the need for change. Higher education is not very well conceived for most students, and particularly for minority students. That is not to say that minority students bring us special problems with them, but rather that these problems only serve to broaden the heterogeneity of the student population in a system ill-designed to deal with heterogeneity.

Some Changes Which Could Help

Effective programs for underprepared students must deal with them on all levels: they must involve all courses, and reinforcement of effects by a unified approach throughout the curriculum. We must capitalize on the benefits of total involvement of a student with his education. For example, one can best get a student to read by giving him something he wants to read. There is important literature coming from the black community on the arts and on the black experience. Probably for this reason reading and writing have suddenly become valued activities there. One sees high school students in the ghetto carrying "Soul on Ice" or "The

Autobiography of Malcolm X" in their back pockets. Students read when they want to read. They will become involved in chemistry when they see some relevance to them in chemistry. Possibly the most important aspect of this is the awareness that they can succeed in the field, and this can be cultivated by giving them examples of successful chemists with whom they can identify.

If the educational programs remain traditional, the only hope for gain in normative standing for underprepared students is through the use of motivational procedures to increase the rate of learning relative to the rate of forgetting. The reason for this is that the performance level of middle-class white youngsters has been moving upward over the years, so the disadvantaged student is faced with competition at an increasingly higher level. Motivational devices--a notion of relevance, the black experience, whatever they may be--must produce a strong drive to succeed in order to lead the disadvantaged student to work much harder than others might need to in order to make up growth deficits and master the same material. The possibility of this is indicated by the fact that well-motivated students -- for example older students -- generally do well even in the conventional educational setting.

Empirical research conducted on discovery learning and creativity has been relatively weak in conception and mixed in terms of results. Both the research conception and the educational application suffer from problems associated wtih their models. The conditions surrounding both the research model and the educational environment are highly controlled and in the case of the classroom, competitive. Almost by definition, these conditions eliminate most possibilities for true discovery and/or creativity to emerge. The possibility of being judged on some task or activity naturally brings to bear convergence or focused attention, rather than the extending of associations or relationships. It is important to increase associations or relationships from the standpoint of increasing both ties between diverse pieces of information and conceptualization or intellectual play. In addition, they provide the basis for beginning or increasing the process of intrinsic motivation which developmentally has long-range implications for the individual.

The mastery of material, the integration of material, and the conceptual activity required to put together diverse pieces of material are all highly desirable educational goals. The individual tendency to extend the process renders it almost ideal. But to develop each of these activities through classroom contacts demands different approaches. The concept of play in the sense of playing with ideas is particularly important. This requires a decentralized classroom, and the use of more game-like approaches and diverse role-playing-type activities.

Expanding Student Support

Institutional academic change is usually a slow, laborious process. Although it does seem necessary to pursue educational change in terms of total conditions in order not to be caught by the traditional interlocking system parts, there also is a need in the interim to broaden at once the student's educational experience around his notion of "relevance" and in terms of support, advocacy, and example. A possible means to this immediate end is to reorient the counseling role to encompass a larger set of activities running the gamut from information source to ombudsman to educational gadfly.

When the Institute for Services to Education initially began to deal with problems in counseling in black colleges, we ran into many of the same road blocks which have already been described in efforts to deal with instruction. Counseling as it ordinarily operates on a college or university campus is largely irrelevant to the problems with which it should deal. Both the faculty and the administration have had an incorrect view of its purpose. In most institutions counseling is one of the functions of student personnel, which is a branch of the administration. The counselor is the individual who tells a student that his grades are too low, that he's been goofing off, or that he is about to be expelled from school. Counselors tend to see themselves as a part of the administrative structure and they hope to use their background in counseling as a stepping stone to appointment as dean or other administrative function. Their point of view largely is that the student must be convinced that he must adjust to a nasty life and that he's lucky to be present in any case, so he shouldn't mind. The counselor is also to a large extent a referral agent who sends a student to the particular subdivision of the university which is expected to deal with his immediate problem: financial aid, testing, the speech lab and so forth. Counseling does not ordinarily deal with the significant problems which students face. Finally, the training of counselors is traditionally a function of the colleges of education and focuses on an image of the counselor as a clinician. This tends to lead a counselor to regard any student who comes to him voluntarily as "sick" and in need of clinical treatment. This usually is not true: students have problems but they are not "sick". Futhermore, the ratio of students to counselors in most situations is so large that there is no opportunity to develop a clinical relationship between counselor and individual students. Even in our program we have only one counselor for 200 students, and that does not permit them to do a lot of work with individuals on a one-to-one basis. Furthermore, the preparation of counselors tends to reinforce a view of the rightness of the institutional approach to higher education. The natural result is that students tend to regard the counselors with suspicion and avoid them whenever possible.

Our model for an ideal counselor requires that he abandon the notion that there is any limit to his job. He is expected to face the total problems of any student who comes to him. This sounds like a simple idea, but in practice it turns out not to be. It requires the counselor to pay attention to the student's conception of his problems, rather than diagnose them from a clinical standpoint. The counselor must be prepared to meet the problems as they arise, and with our students that may mean difficulties with law enforcement agencies, with poverty at home, with draft counseling, with available jobs and the qualifications for them, or even with how one can carry on despite a bad crop. In addition to attacking the whole set of problems of our students, we ask our counselors to interpret the institution to the students and vice versa. Finally, the counselor must serve as a model for personal development and problem resolution. We desperately need models the students can emulate, and we ask our counselors to be strong models. This does not mean that they are expected to argue with the students about their life-style. It does mean that the counselor is to accept the student as a human being interacting with society and challenging an often inadequate educational system. It requires the counselor to confront openly the significant questions of the times for students: the nature of society and personal morality, issues of black power, integration, separatism, or nationalism. A counselor on one of our campuses who is not familiar with these issues or is uninterested in them has no chance to identify with our students. At the present time, whites cannot exercise a leadership role (for example as counselors) in dealing with minorities. Instead they provide resources and support for leaders from the minority group. It is much easier for a minority group leader to work effectively if he has strong backing from a white with the power and personality to absorb and deflect attack.

Finally, we ask our counselors to assume a political role in the university -- to wheel and deal to the extent that is necessary. If a new course is needed, the counselor should see the need and work to get it started. If there is a need for a reading tutorial program he should get that started. He should know who the people are around campus who can get things done and are willing to put out the effort to do them. He should know where free psychiatric help is available, what clinical services might be available to drug addicts, or how to relate back into the community. Many students today are strongly interested in the community and community projects. They want to be involved with their people. The counselor should be aware of what is going on and what is needed in the black community, and be able to suggest to students how they can help with real problems.

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STUDENT REACTION TO TEACHER STYLE

Barry Clemson

I shall discuss some matters related to teacher style, based not upon the contradictory professional literature but upon a lot of idea swapping and attempts to pull things together by a group of active teachers over a period of years. The group includes a few university people: biologists, an English professor, physicists, and a few others, together with high school teachers mainly from the inner city, and on down to pre-school teachers. It is a varied group that has been struggling with the articulation of some ideas about education for a long time.

Let me begin with the issue of motivation. Consider a student who comes from a culturally-deprived background -- maybe someone from what I call the street culture, possibly he's been a hustler -- before whom we in the university start holding up some examples of what we may call the middle-class style. He knows one culture -- is thoroughly familiar with it -- and also knows all its disadvantages. He wouldn't have tried the university if he didn't have aspirations toward some other life style. But the point simply is that seeing this new possibility without being sure you can make it, puts one in a state that generally causes extreme anxiety. In most cases the underprepared student is highly motivated in the sense that he wants to succeed in college and has usually overcome severe difficulties to get there. Coupled with this he has a very low self image. In other words, he has a great desire to make it through college, but along with that, he doesn't believe he can. His self-image relative to mathematics is: I can't do it. His self-image relative to science is: I can't do it.

That results in two kinds of behavior. Suppose you give that kid a word problem that requires calculation of the age of your grandfather; if he gets eight years as the answer, he's perfectly happy with it. He simply hasn't thought about the problem. I call it grabbing an answer. Or possibly he doesn't try at all. Not to try means that you cannot fail. And you see both tactics over and over again. Both indicate on the surface that the student is not motivated. Low motivation combined with low self-image of course can result in this failure to try. But high motivation and low self-image very often produce the same results: don't try, or just grab an answer. Anxieties of this type make the student quite unaware of the need to examine the processes that he uses to attack a word problem. Even a student who can get a right answer to his problem can't begin to tell you how he got it. These are the dimensions of some of the problems I want to talk about.

Now let us consider how you can deal with that self-image. How can the teacher change the student's self-image from "I couldn't possibly deal with science" to "I can handle it; it may be a struggle, but I can handle it." For this purpose I want to talk about the instructional content, about teachers' stylistic faults, about the structure of the instructional setting. First let me point out the nature of the models that this teachers' group has hammered out: our thought has been that we need to get something articulated, that we can't even see where we're wrong until we propose some sort of model that at least lets us see how it fails. That's the sense or the mood in which I'd like to throw this out. I feel one is on very dangerous ground to talk about this, but I think it's so crucial that we are compelled to begin to struggle with it.

On the question of content, let me raise the issue of relevance. It seems to me that students themselves can't articulate what they mean by this cry. To me there are perhaps four major points. The first is that students want teaching somehow to relate to their own experience. Furthermore, it ought to have some practical use: they ought to be able to see some way they can use it. The second point raised by minority groups, particularly blacks, with the cry of black this and black that has to do with historical roots. How have my people contributed to this? Both of these points seem fairly clear. The third gets us off on something that might be a little new: the cry of relevance also has to do with the question of the philosophical issues involved in the field. As an example, we've been using a paper called "Fixing Belief" which deals with how one comes to believe things. One way is based upon appeal to authority. I believe things because I'm in an institutional milieu that has brainwashed me on these ideas, or I just accept them on authority. Another possibility is that things just get repeated to me over and over in a non-authoritative setting and I gradually come to believe them. Another is the way of a priority: things seem reasonable in the light of my experience. The fourth way is the method of science. We can't do away with other ways of fixing belief, but science is the only way that offers us a freedom of choice. We're trapped by all the things we believe, on whatever basis. To deal in depth with that kind of issue with a group of students (any student of high school age can deal with the issue) requires that one start by relating to their own lives since you must pull out examples of matters in which they believe on these various bases. It begins to make the basis of belief a concrete and real issue to them. Alternatively, one might deal with the way science and world view and values have interacted. Examples of this kind of shift have occurred throughout history. A good example occurred in the late middle ages when mechanics produced a picture of the universe as a big clockwork, and that picture from science interacted with man's view of himself -- with theological and philosophical issues. (In fact, the way these may be relevant here.) And the last aspect of relevance: students are extremely concerned with the kind of moral imperatives that come out of a discipline. In chemistry probably the most obvious example is pollution. Beyond that, just what kind of demands does chemistry make on my way of life? They're very much looking to us to have opinions and take stands on those things.

Let me quickly tell you something about style. The point of dealing with this is that style communicates so loudly to the student that he may never hear what you have to offer in terms of content. The first thing I must talk about is commitment versus detachment: students are looking for instructors who are enthusiastic. It's obvious from the style of a good chemistry teacher that chemistry is important. He gets excited about it. Style also has to do with the philosophical and moral issues, I believe. Style involves one's willingness to deal with these issues in the context of one's discipline. Much of what I have to say here cuts against our traditional academic image. It raises the issue of the teacher as co-learner versus the image of the teacher as expert. It seems to me that particularly if you're using something like discovery method, every teaching situation involves something you can authentically learn from it. The style of the expert tells the student that academic life is about piling up answers. The style of co-learner tells the student that academic learning does not have anything to do with life: no moral imperatives, nothing that touches on his life except the top third of his head. To me this is what McLuhan meant when he refers to the medium as a message -- the style and the structure communicate something.

I use the terms radical versus liberal for another aspect of style. Someone has already said it by "I've got to force the student to get tutored. I'm not going to be permissive." Another is the response to the student who says, "I can't deal with this; you're over my head." You tell him, "Stop playing stupid. You're not stupid." Well, that's the kind of thing I mean, having high expectations. You don't say, "Oh, gee, it's really too bad that you've had such a terrible education." That's not what is needed; you need to kick him and pick him up at the same time. Another illustration is the alternate modes of functioning as counselors. The liberal is out to help the student on a specific issue that falls within his area of expertise. The guy with the radical style is out to deal with the student's life. This is done only at high risk of offending the student. It illustrates an active versus a permissive approach to the student's problems. I'm talking about trying to provide words versus trying to provide images, or the absolute versus the relative. That dichotomy involves two aspects. First of all the question of answers: I'm convinced that in today's world our instruction has to emphasize tasks which do not have a single right answer, but have alternative possible plans of attack or alternative workable solutions. The laboratory exercises that have right answers won't do. Even test questions that have just one answer are perhaps not as good, but changing that requires hard work! Possibly you may have one correct answer with a lot of different ways of arriving at it, and then grade the student on the way he approached it. The other aspect has to do with the moral system. A student will happily cheat on an exam if it is a true-false exam that asks him only to regurgitate material. If you give him a task that's authentic he's not about to cheat on that. But it goes a lot deeper than that. The point is that the only way you can belt a student relative to his self-image -- and at the same time pick him up -- is to put yourself in his value context. It is hard for us bourgeois, middle-class, professor-type people to talk with a student off the street. Instead of coming at the student with preconceived ideas about what it should mean for him to succeed, you try to get inside of him to find out what his concerns are and deal with him as a total being instead. I think that's crucial in dealing with minority students whose cultural values are different, particularly if it's a student who comes out of one of the street gangs that most of our big cities are full of.

Now a few quick words about structure of the instructional setting. I'll talk about the structure of your daily class, the weekly structure, and maybe the structure of the term. For example, our Chemistry 110 course begins with a weekly seminar which opens with a "conversation" that is just out to raise an issue. We decide with the class what kind of an issue needs to be confronted. For example, the students felt that if an experiment failed it was no good. So we tried to raise that issue. Then the seminar continues with a lecture which is out to get *image* across. Not information, but an image or a new idea -- I always say that a lecture is not designed to tell the student something he doesn't already know, but it's out to convey a mental picture, and of course a picture related to the issue you've raised. You're essentially doing an effective job here and not a cognitive job. And then the third part of this structure was either a seminar or a workshop. I maintain that what that structure says to the student is that we're all in this together and we're going to struggle and we're going to learn something, whereas a traditional lecture with study assignments says to the student that I'm going to fill you up with data. This message too is more potent in psychological impact than the content message you're trying to get across. The content has to compete with these messages and does not have the wallop that they have. An illustration of an effective lab situation is our lab work with a model slot car. You put the student in a situation that to him is ambiguous; he doesn't know quite what to do. You hope you have defined it so that all of the sidetracks he can go on bring him bumping into a fence; you know which alternatives he's likely to come up with. You have it highly structured but to him it's ambiguous and puzzling at first. We do that with small groups of people, usually three.

The structure for the week for our Chemistry 110 involves a seminar where we struggle together with some issue. The focus of the seminar is on the broad view, the context, and on methodology. Then we have small group sessions (like the stock car problem) where the group is faced with a task. The aim here is to deal with methodology and skills. Finally we have individualized study assignments which focus on specific skills. Now I don't think we have these separate activities tied together well enough yet. But if we do it well it should all fit together in terms of context and methodology and the specific skills needed to complete it. We try to make the course image more real to the students by introducing a diagram while we give these lectures. Somewhere near the beginning we'll diagram problem-solving -- we usually make this pretty large -- and then we'll add model-building, and finally processes of science and tools of science. These are the three aspects of the course and there's overlap among them. But this is a way to provide students with an image that holds together the content of that course. It does no good to stand up and say this course is a unified course. You've got to give some kind of picture that holds the course together. And the diagram was an attempt to do that.

To me these are the considerations that one must begin with in designing curriculum. After that you select your particular content: Newton's First Law, something about combustion, or what have you. But to me these are the really tough problems in teaching.

THE USE AND ABUSE OF BEHAVIORAL OBJECTIVES

Susan Markle

Psychologists and educational technologists are agreed that terms like "real understanding" do not contribute a useful educational objective because there is no agreement on what they mean. What we need is an agreed-upon criterion for "real understanding". Suppose that we try this: a person who understands chemistry behaves like a chemist when tested under the same conditions as a chemist works. Chemistry, like other disciplines, is a way of looking at reality in terms of concepts (classes), of conceptual structures (hierarchies of classes), and principles (stated relationships between classes).

This discussion will concentrate on the analysis of subject matter concepts in terms of student behavior which we can agree demonstrates understanding. The key distinguishing behavior characteristic of an expert in a field is the ability to recognize all possible instances in a class and to reject all possible non-instances. (This of course assumes unanimity among the experts!) This suggests that a student should be introduced to a new concept by the presentation of both rationally-chosen instances and non-instances as examples, with an analysis of the bases for their differing classifications. The analysis of subject matter concepts is not easy. One tends to turn first to textbook definitions, but these have rarely been tested for their effects on student behavior, and they may not influence it favorably. They also are seldom exact, at least in the social sciences and humanities, and not always in chemistry. For example, what would be an exact and agreed-upon definition of molecule?

The most influential book on behavioral objectives or specific objectives was published in 1962.* The emphasis since then on observing student behavior is more revolutionary in education than it sounds. Conventional educational objectives usually have a high connotative value but no operational specificity: we talk in terms of the student acquiring understanding, appreciation, attitudes, knowledge, or skills. Furthermore, course outlines and college catalogs usually are based on descriptions of what the teacher does, rather than placing the emphasis where it should be: on what the *student* does.

Preparation of behavioral objectives seems simple when viewed in the abstract: a good behavioral objective contains a statement of an observable action or behavior expected of the student under clearly stated conditions and criteria for acceptable performance. "Behavior," "conditions," and "standards" make it sound much simpler than is actually the case. A useful behavioral objective must be stated in terms of student (not faculty) behavior. Observable modes of student behavior include what they say in class, do in the laboratory, or write on papers and exams. The behavior desired must be explicitly stated or clearly implied. The conditions must be stated precisely in terms of the materials with which a student is expected to work. For example, the calculation of a statistical correlation is a very different matter when carried out by hand, with a slide rule, a desk calculator, or a programmed computer. Construction of a molecular model varies with the starting materials and the detail in which information on structure, geometry, or bonding is to be conveyed. The specification of standards may involve a number of different aspects. One of these is the level of student performance (degree of perfection) expected. Objectives with unstated standards force a reader to assume that perfect performance is expected. This is not always reasonable, and possibly some lower standard might be set to allow for computational errors or examination pressures. A behavioral objective stated for a laboratory operation might set standards on maximum breakage or time for performance. In short, a well-stated behavioral objective is specific about the behavior to be observed, specific about the conditions under which the student will perform, and specific about the performance standards against which the student will be evaluated.

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*R. F. Mager, "Preparing Instructional Objectives," Fearon Publishers, Palo Alto, California, 1962.

We turn now to useful applications for behavioral objectives. It is obvious that they provide a clear specification for test items for measuring student achievement. Most college-level testing is carried out on a norm-reference basis, which means that one assumes that imperfect student performance is adequate. Testing guided by precisely-stated behavioral objectives can be carried out with an absolute performance criterion. This is precisely why the new instructional technology has had so much more impact in industry and the military than in the academic world. In those cases, the object is perfect performance in a limited performance area. Academic instruction tends to be deliberately open-ended, in part because we tend to think of all of our students as potential professionals. Furthermore, behavioral objectives permit a shift in emphasis to criterion-referenced testing by which a student is tested against a clearly-stated absolute standard. In addition, objectives help to keep a teacher's eye on the teaching goal during instruction. The behavioral objectives define the minimum which must be covered, and provide a better fix on which instructional experiences are relevant and which may be simply frills or side tracks. Objectives have proven extremely useful in industry in eliminating overtraining. This concept jangles the nerves of most college instructors; how can anyone know too much about his subject? However, in planning a course for the chemical technologist or plant operator it might be useful to be specific about objectives in order to eliminate training which is present only because it is traditional rather than essential for work in that particular field.

Finally, behavioral objectives are essential aids in the operation of multiple-section courses. As one example, they are in use in a course in economics at the University of Illinois in Urbana. Teaching assistants in that course know precisely what their students are supposed to do, and they are evaluated as T.A.'s on the performance of their students. Experience there has been that once instruction has been refined to achieve the objectives consistently, the professor raises the level of the objectives and of attainment that will satisfy him. Improvement of the course is thus endless!

A second application of behavioral objectives is the evaluation of instructional success. Our whole educational system is oriented towards evaluating the student and blaming him for failure. If he doesn't learn, he's unintelligent, immature, defective, disadvantaged, or any other term which puts the blame on the student. It is hard for most college professors to accept the notion that they might be accountable for student performance. If a student does not achieve what the instruction was intended to help him achieve, the fault can very possibly lie with the instruction. Validated instructional programs are built in a recursive cycle which requires try-out with students followed by revision in the light of that experience, then new tryouts and revision until they prove workable. Most instructional materials now on the market have not been designed this way. Professional programmers operate on the basis of the motto "If the student errs, the programmer flunks." The same philosophy clearly can be applied to instructor accountability.

A third reason for the use of behavioral objectives is the help they provide to the students in understanding exactly what is expected of them in a course. One reason that students fail to exert their best efforts is that it is not clear just what is expected of them. In my experience, students will badger an instructor for additional explanations and more examples until they are certain they understand the material, *if* they know what is wanted of them. Too often our instructional procedures are cat-and-mouse games in which the practice is to keep the student in the dark about what is expected. Each examination is supposed to be a total surprise. Course goals stated as behavioral objectives do not mean "teaching students the test"; instead, they tell students precisely what will be measured by them.

In short, there are excellent reasons for setting up behavioral objectives. An instructor then knows exactly what his goals are, so he can select instructional activities implied or required to attain these objectives. He knows precisely what he wants to measure, so examinations become feedback for himself on how well instruction is proceeding and where more effort is required. Furthermore, students know what is expected so they can direct their energies to the proper goals. A possible but as yet unexplored use of behavioral objectives in teaching would permit the student to select those parts of a course in which he would do serious studying. A student could then be evaluated only in terms of the selected parts of the course. This would involve a major development project, but would also confer enormous flexibility in the adaptation of courses to specific student interests.

One way to provide such objectives would be to state them in terms such as the following: "a student will do a or b or c . . ."

In spite of the advantages they afford, it is clear that there is considerable resistance to the use of behavioral objectives. Possibly the most important reason is difficult to deal with because it involves the egos of faculty members. Objectives imply to them a mechanization of instruction and possibly a loss of intellectual content which conflicts with their professional view of themselves. Furthermore, the list of objectives is public property. It is relatively easy to judge the effectiveness of instruction against such a list. Another reason for opposition to behavioral objectives is basically political. We have come to expect complete academic freedom in teaching at the college level. Today this seems to imply freedom to act as one pleases in the choice of course objectives and consequently content, as well as in the choice of teaching methods and examination methods. It may explain why we tolerate the discrepancies which have been observed repeatedly in grades assigned by separate graders to an examination written by a particular student. One tends (with unwarranted smugness) to assume that these difficulties arise only in the humanities and possibly the social sciences. Unfortunately, the experiment has also been carried out with members of a high school science department with the same result: grades assigned to a specific examination covered a wide range. Of course there is not as much agreement among science instructors on performance standards as one might like to imagine when one is talking on a level of what the student should learn.

Another reason for opposition to the use of behavioral objectives is the enormous difficulty in proposing a reasonable set for an entire course. We have learned that preparation of instructional programs requires ten-to-one hundred times greater expenditure of time than preparation of ordinary written instructional material such as a textbook. It has been found that nearly forty percent of the time devoted to developing a training program is required for analysis of the tasks the students are expected to perform and a statement of criteria for adequate performance. This time must be invested before the programmer selects the instructional experiences to be used or writes anything. It works out to about twenty hours devoted to analysis of goals and methods for each hour of instruction finally produced. The same sorts of problems arise in listing behavioral objectives. It is relatively easy to obtain agreement on objectives stated in vague general terms which may begin "the student will appreciate the significance of . . . ", which is not very specific, means something different to every hearer, and thus is very easy to agree upon and meaningless in execution. It also is relatively easy to turn out long lists of trivial objectives. Very likely these do more harm than good, because they tend to kill student interest.

Finally, there is great reluctance to define academic performance requirements in terms of a *minimum* performance level. On the other hand students tend to appreciate such a definition. Education ultimately must be open ended, and most academic people feel there is something limiting in setting up explicit objectives. But failure to do so very possibly has thwarted the ambitions of a lot of youngsters who were thus denied an opportunity to demonstrate their full potential because they were moved at an early stage into badly-constructed courses. Possibly one could retain the advantages of course definition through behavioral objectives but at the same time maintain open-endedness by stating only a minimum list of objectives. Specific objectives are always open ended in the sense that they do not specify teaching style or how the objectives of the course are to be achieved. This permits individual variation in the approach to teaching even a carefully-defined course. Furthermore, objectives need not be stated in a way which limits course open-endedness. For example, one might include behaviors such as the following:

1. willingness of the student to move beyond specifically-stated course content.

2. willingness of the student to use extra time in open laboratory for extra work.

3. willingness of the student to take a topic beyond the initial narrowly-stated form.

Mager has proposed as a high-level objective for every teacher that the student leave the course with at least as favorable an attitude toward the field covered as that with which he began the course. Objectives such as these imply "behavior as a chemist," and retain a desirable open-endedness.

Active teachers are much more successful at *selecting* instructional objectives which they consider worthwhile than they are at writing them. A teacher can easily perceive which objectives fit his own view of what is required in a course. Most of them would require professional assistance in proposing objectives from the beginning. Nevertheless, it may be that the effect on faculty of the struggle to state objectives is more important than the list which is finally produced.

COMMENTS ON TESTING AND PLACEMENT

A Collection of Material from the Discussions

Educational institutions at the college level have traditionally relied upon some combination of high school performance records and standardized tests (usually those administered by the Educational Testing Service or by American College Testing Service) to predict the performance of prospective students. The use of these test criteria for selection of students has recently come under heavy fire, particularly from members of the black minority. They claim that the standardized tests are biased in favor of the white middle-class culture, that they discriminate against the graduates of low-quality inner-city secondary schools, and that they fail to allow for broad differences in values of the black and white communities.

It is a fact that members of some minority groups generally average about one standard deviation lower on standardized tests in English or mathematics than do white students. On the other hand, students from Oriental backgrounds do as well as white students. A number of efforts have been made to demonstrate discriminatory bias in testing, and all have had negative results. There is a possibility that these efforts to evaluate the effects of testing on minority group students have themselves been biased by their application to relatively selective colleges with homogeneous student bodies. However, the data appear to be about the same for correlations of test scores and college performance of black students in integrated colleges and black students in predominantly black colleges. Even these data may reflect homogeneity produced by the self-selection of students to the schools they attend.

Other evidence has been used to support the predictive value and absence of minority group bias in existing standardized tests. This derives from the fact that data on students who are admitted to *normal* undergraduate programs on the basis of "special" selection criteria show that they do not perform nearly as well as students selected by normal criteria. Their performance is sometimes improved if they follow special curricula designed to recognize and minimize deficiencies and to build on the special strengths of these students. This is the basis of the ISE program described in the paper by Dr. Colquitt. The community of chemists (and those of the other professions) is international, so clearly these special educational efforts must eventually develop students who can operate on the conventional terms imperfectly developed by conventional educational procedures. In particular, mastery of conventional communication techniques and mathematics is ultimately essential.

The data which have been summarized in the preceeding paragraphs have been used by the testing establishment to support the reliability of their tests and testing procedures. Another viewpoint, presented in the paper by Dr. Parmeter, holds that the nature of testing procedures for both admission and course grades and the nature of college level courses are such that entrance test scores become self-fulfilling predictions. Furthermore, tests measure only the growth aspect of intellectual capability, and are incapable of measuring development or creativity.

There are a number of recognized deficiencies in the conventional standardized tests. They provide no measure of motivation. They do not clearly specify the behavior or behaviors which are required for academic success. Furthermore, it is not clear whether the examinations test these factors directly, or merely test factors which usually are related to these behavioral criteria. There are some weaknesses in test procedures. Test conditions which because of time limitations or psychological factors produce pressures on the students taking them, may discriminate against particular population groups both when they take the predicative examinations and the examinations to evaluate course performance. These effects of the test environment on results are not really understood.

There is some rather sketchy evidence that the distributions of ability patterns for minority groups are somewhat different from the white majority. The usefulness of direct tests for these will depend upon the development of curricula devised to take greater advantage of the same characteristics. Efforts are under way to develop new tests for use with minority groups which are designed to reduce the dependence of test results on cultural background factors which might discriminate in favor of white students. The availability of successful tests of this type may have the important result that it will become possible to select among applicants who do not meet normal standards in communications or arithmetic skills those students who are most likely to perform successfully after these deficiencies have been removed.

It should be pointed out that correlations between test scores and subsequent grades reflect errors in both of the correlated factors: test scores and assigned course grades. The correlation cannot be better than the product of the separate reliabilities. It appears that both SAT and ACT tests are reliable to about 0.9. Individual course grades are much less reliable than this, although average grades are considerably more reliable. The product of these error terms gives the correlation between test scores and college performance, which falls in the range 0.4 to 0.6.

The predictive value of all standardized tests decreases with time. That is, the correlation is best between test scores and freshman grades, and declines through the succeeding years of college. Correlation is quite poor between test scores and "success" in after-college life. One problem here is the lack of an agreed-upon quantitative criterion for success. There is some evidence that participation in extra-curricular activities correlates better with adult success than do any sort of test data or college grades.

THE PROGRAM OF THE INSTITUTE FOR SERVICES TO EDUCATION

Leroy Colquitt

The Institute for Services to Education (ISE) began operation as a non-profit organization in 1967 to improve education in colleges which enroll predominantly black student bodies. As its major effort in curriculum change, it coordinates two curriculum development consortia in nineteen colleges throughout the southeast. This project was sponsored by grants from the Carnegie Corporation, the Ford Foundation, the National Science Foundation, the Division of College Support of the Office of Education, and the Bureau of Research of the Office of Education.

Each institution participating in the ISE program sets up an autonomous experimental college which offers a four-semester liberal arts program under the supervision of ISE. The program requires the students' full time during the first year, and half time during the second year. One hundred students are selected at random from each normally-enrolled freshman class for participation in the program. The experimental college has its own director, a student counselor, and teachers who in many cases have been recruited for this special program from the regular college faculty. There are two teachers in each of six disciplines: English, mathematics, social science, philosophy, humanities, and science (biology and physical science). Faculty members involved in the experimental college program have reduced teaching loads (two classes of 25 students each) and are expected to devote major effort to curriculum development and assessment of results. Students enrolled in the program sponsored by ISE live with other students and participate in normal college activities with them. They simply take a special group of courses which occupies most of the first four semesters of college; these courses are designed by ISE to provide a background liberal education from which the student will continue in a regular major in the college in which he is enrolled.

ISE has a home office staff of approximately thirty which includes two professionals in each of the disciplines in which courses are offered. Most of these individuals have had teaching experience in a black college. In addition, it offers consultation services on specific problems as they arise during the academic year. It conducts a short spring conference which brings together staff and faculty members from the participating colleges to assess their results for the year. Finally, it conducts an eight-week summer conference which involves all faculty members from all of the experimental colleges. The summer conference serves as an orientation period for new faculty, provides an analysis of the past and of the coming year's operation, and it heavily involves the participating faculty in development of curriculum units in fields which they teach in cooperation with the ISE staff and outside consultants. Thus, a basic characteristic of the program is the development on a very broad basis of new curriculum materials by the faculty members who actually will be using them. A general result of the summer program has been the growth of the teachers concerned through participation in the development of these course materials.

The ISE physical science course is designed to involve the student from the outset in doing science, rather than talking about it. It focuses on science as a process. At the beginning of our program we depended heavily on the use of standard texts for our course because we had not then developed an alternative to the traditional highly-sequential structure of a science course. We were searching for an approach which would allow for greater flexibility in the choice of topics and level of attack and yet would provide in an orderly manner the prerequisites to attack any specific problem. We have since then developed our own material which we believe does these things and forms the nucleus of our course. It is based upon five units which cover five topics:

1. nature of science
2. light
3. inorganic and organic chemistry
4. conservation principles
5. gas laws and kinetic theory

Each unit is self-contained, starting with a fundamental concept and developing in a spiral fashion through a hierarchy of levels. Each level contains the development of at least one fundamental idea from empirical data obtained in the laboratory, the demonstration of the utility of the concept, and a natural termination point that permits a study to end at a variety of levels always with a sense of completion. By virtue of their self-containment, a given unit may be interchanged in a course sequence with almost any other; consequently, a teacher constructs his course around the sequence of units that best suits his own interests and the background of his students. A discovery approach is emphasized: the effort is to lead the student through laboratory exercises which will bring him naturally to ask questions designed to reveal the principles of the topic. The faculty member plays a vital role in this operation by pulling together the piecemeal observations of the students to arrive at generalizations and abstractions.

In a one-semester course in physical science, time is a pressing constraint and the rigors of a discovery approach to learning are often difficult to meet. For example, in the introductory stages of our study of chemistry it would be ideal to have students discover the patterns of chemical combination themselves, but this is impossible. Nonetheless, we are able to provide an environment which generates an analogous experience. We use a chemical balance to model reacting systems -- this is a rough balance on which packages with a unique arbitrary weight for each element can be balanced against a standard weight for allowable combinations of elements. The student uses the balance to determine atomic ratios in existing substances, and is then urged to predict combining ratios for additional substances by analogy with known cases he has already discovered. Information from the chemical balance is reinforced by use of the computer for drill on chemical formulas. A student can either verify combinations which he has discovered on a chemical balance, or try out new cases on the CAI terminal. The instructional program is designed to refer the student to outside sources for additional information on new compounds. The entire experiment is designed to be used over approximately a week of class time, but the effects of the analog experience form a base on which to build the remainder of the course.

We are also able to start students on organic chemistry very early by exposing them to models. They use their models to develop relationships between molecular symmetry and chemical properties. They work with the recognition that the models they construct are not necessarily precise reproductions of actual molecules, but that they are a useful device to help them to visualize certain relationships. In this way insightful connections are made and students generate a curiosity about topics usually covered only in more advanced courses, e.g., the relationship of molecular structure to physical properties, about stereochemistry, or about the absence of compounds for which plausible formulas might be written. Students can look up molecules for which they have prepared models in a card file which lists various properties of these substances. The card file or the computer program can refer the student to the library, to the laboratory for additional investigation, or to a teacher in order to accumulate additional information to solve problems he has raised. Every effort has been made to design the units so that the student will be encouraged to ask questions and to proceed on his own to conduct investigations within the limitations of his current knowledge. Again the emphasis is on independent and creative action by the students.

We feel that the philosophical bases of our program are unique and are vital to its success. The first of these is the expectation that curriculum units and teaching materials to be used by a particular group of teachers will be most effective if they are developed by those teachers who will use them. We want to encourage continuing development and innovation by avoiding publication of a massive bound volume of immutable course material. A looseleaf format encourages continuing addition and deletion of material, and encourages continuous testing and revision. One objective of the program is continuous growth and change -- a notion which most of our teachers at first find very difficult to accept and act upon.

The educational philosophy for the courses developed by ISE requires that students become involved with each subject in a way which will lead them to ask questions about it in a natural way. The program must provide a setting in which these questions will arise. It must focus initially on the students' acquired strengths, rather than emphasize their weaknesses. In the English course, this means that one begins with an admission that there are many ways to communicate, that those methods based upon body language, tone, or rhythm must be emphasized initially, and only later does one turn to development of ability to communicate in conventional English, with elimination of weaknesses. In mathematics, the program is designed to involve the students in operating as mathematicians operate, to begin with specific problems and from these develop abstractions and generalizations.

The teachers involved in the program have a faith in their students and operate on the fundamental assumption that even the students with low ACT scores are bright, potentially good students. They believe this firmly enough to display complete confidence in the program and in their ability to help the students in it. Faculty members not only *profess* to believe these things, they *act* as if they belive them. This makes for a very effective relationship with the students -- one which we consider essential in the effort to raise the operational level of performance of these students, who enter their colleges with ACT scores which center one standard deviation below the national norms. The program operates on a fundamental assumption that one needs to broaden the experience base of the student, to allow him to develop on his own terms without imposing upon him a base which is unnatural.

One of the most important questions that we have had to face is "How does the program affect a student's progress through his major discipline curriculum sequence?" There is no simple answer to this, for a great deal depends on how the major departments respond, i.e., how they compare the program courses to beginning courses in the "normal sequence" and what modifications they are willing to make in that sequence for program students. The colleges adopting the program have been far sighted enough that it is the rule that our first-generation students now entering their senior year are on schedule in their major fields. The mechanism for this varies with college and discipline. Some departments use our courses as alternatives to "regular" departmental freshman or sophomore courses. Others construct a modified junior year curriculum which contains a concentration of major courses usually taken in the sophomore and junior years. Yet another method is to parallel the "normal" courses for an extra semester with special courses designed to build on the strengths developed in the ISE courses. In any case the results are impressive. All of the data are not yet in, but we may cite the program at Jackson State College as an example. Of one hundred students who began their freshman year three years ago, eighty-one are entering their senior year on time. Of these, nineteen are majors in biology, chemistry, or mathematics. The overall matriculation success rate is almost twice that of the regular program or the national average. The high percentage of science students in the senior class speaks very effectively for the success of the science program and the way it was integrated into the regular program.

The program has transcended the level of an experiment and is becoming a part of the regular program in a number of our colleges. As of this year, nearly all of the nineteen colleges in our consortia have moved to begin integrating our program into the normal curriculum structure or plan to do so beginning the 1971-72 academic year. In several of our colleges the entire freshman class is engaged in a modified ISE program. Many more will follow this pattern next year.

THE PROGRAM OF THE COLLEGE EDUCATION ACHIEVEMENT PROJECT

Mattie T. Grigsby and Luns Richardson

The College Education Achievement Project (CEAP) was launched in 1967 to develop and test in a number of colleges educational materials for high school graduates whose preparation would not otherwise qualify them for college work. It is supported by the U.S. Office of Education and (through grants to students) by the Office of Economic Opportunity. Centers connected with the program are operated on fourteen campuses of predominantly black colleges in the south, with a central office in Atlanta.

The center on each college campus is staffed by seven professionals (teachers in English and mathematics, speech and reading specialists, two counselors, and a campus coordinator who carries out administrative duties)together with three undergraduate student tutors and twelve teaching assistants. Each campus center serves approximately one hundred students who are selected from applicants who are below the minimum level of acceptance for that particular college, or who are evaluated as high risk students at those colleges which operate on an "open-door" basis. These students are considered regular members of the freshmen classes at their institutions, but they are assigned to the program of CEAP. They spend a minimum of one semester and a maximum of one year in that program. It is possible for them to earn partial college credit during this period on the basis of their demonstrated achievement.

The CEAP program is designed on the premise that there are many students who come to college with or fail to be admitted to college because of basic deficiencies in the communications skills: reading, writing, speaking, and organization of ideas, together with mathematics. The purpose of the program is to help these students overcome their deficiencies in these areas. The program also is designed to strengthen the self-image of these students and to aid in their social adjustment to the academic environment. The CEAP program accepts students who would not gain admission to that college under normal selection procedures in the hope that five-to-nine months of intensive remediation will permit them to move into the regular college program with some probability of success. We expect that most of these students will require extra time to complete the normal four-year undergraduate program. The CEAP group which entered Johnson C. Smith University in the fall of 1967 has lost some of its remaining members each semester. At the end of three years, approximately forty percent of the original group was still in college. This loss does not reflect the failure rate in the program, which is in the range of five-to-ten percent of the entering group. Instead, the pressures of the draft, early marriage, or financial problems make it impossible for some students to complete their work for a bachelor's degree. Financial difficulties arise because the OEO grants terminate when a student moves out of the CEAP program into the regular college curriculum.

While the student is in the CEAP program he pays no tuition because the USOE grant covers educational costs. College and OEO funds are used for grants to students in the program to cover living expenses on campus. There is no difficulty in locating students in the south whose family incomes fall in the range which makes them eligible for OEO grants.

On the Benedict College-Allen University campuses, statistics on students who have completed the CEAP program and are now engaged in regular college work indicate that they average better than C in their college studies. This seems encouraging for students who would not even have been admitted to these colleges under the usual admission standards, and who probably could not have succeeded there without special remedial efforts at the beginning of their careers.

CEAP students are not permitted to hold jobs, so they have full time available for the academic program. Counseling efforts for those students who do not succeed in the CEAP program have not been wholly successful. Some students are advised to transfer to a junior college or to vocational school if these seem to be more suited to their abilities. Unfortunately, many students resist this advice once they have tasted the college environment, and consequently they drop out of education. Other students who have moved to a junior college have done quite well there and subsequently apply for readmission to a four-year institution.

CEAP students take placement examinations along with regularly-admitted freshmen during their orientation week. Those students who score well above the cutoff point in any area -- English, reading, or mathematics -- are excused from the CEAP program in that area and proceed directly to the regular freshmen course. Students who do not earn adequate scores are required to take the appropriate remedial work.

CEAP maintains a small central office staff in Atlanta. This staff furnishes overall administrative direction for the program, sets up training programs for the staffs at the individual centers, promotes exchange of information between the centers and provides them with related materials developed outside the CEAP program, and carries out evaluation of both the overall project and the individual centers.

The central staff devotes substantial effort to preparation of teachers for the individual centers. This is necessary both because there is a shortage of teachers trained in compensatory education, and because the unique nature and methods of the project require special training. This is provided through faculty conferences at the individual campuses, school-year workshops which bring the faculty members from all centers together twice each year, and summer workshops which have been held at the University of Tennessee. These summer sessions emphasize the study of special problems which arise in instructing CEAP students. They are also devoted in part to the development of appropriate instructional materials which have taken the form of manuals which are subject to yearly revision during the workshops. The project also provides funds for staff members at the campus centers to attend appropriate professional meetings such as the National Council of Teachers of English or the International Reading Association.

The CEAP program has been accepted with some enthusiasm at the campuses where centers exist. A number of these institutions have adapted the program for use as part of the instructional sequence for regularly enrolled students. The program also has generated support by high school guidance counselors and principals, as well as the parents of high school seniors. The large majority of CEAP students at the centers are enthusiastic about their work, apply themselves seriously to their studies, and are making reasonable progress. It appears that the program is having beneficial effects on the counseling and administrative programs of the participating colleges as well.

THE CEAP PROGRAM IN REMEDIAL COMMUNICATIONS SKILLS

Luns Richardson

The average achievement level of black high school graduates through the country is approximately four grade levels below the national average. This is symptomatic of ineffective and deficient language skills in writing, speaking, reading, and listening. The CEAP project has designed and is offering a remedial program designed to meet the basic needs of these young people in these areas. We have tried to approach the problem creatively, and not simply add another year of conventional course work of the type which has already proven inadequate to help these individuals. The achievement level of each student accepted in the CEAP program is determined through tests administered during the orientation period and by evaluation of high school records. On the basis of this information and personal interviews, a daily schedule is designed specifically for each individual student, with provision for extra time to be devoted to the areas in which deficiencies are most serious.

The basis of the CEAP program in communications skills is what we have called the reaction concept: the student's own reactions to situations which are meaningful to him are used as the basis for oral and written verbalization and as motivation for his reading. We tackle all of the areas of communication (reading, writing, generating and organizing ideas, and speaking and listening) simultaneously because we feel that they are linked and cannot be separated in teaching. The California and Nelson-Denney tests indicate that 75 percent of the students in the CEAP program read at the fourth through ninth grade levels. Reading is a complex skill, and we feel that improvement for these students requires individual attention in a laboratory situation. This is provided through a fulltime remedial reading specialist who devotes most of her time to individualized remediation and developmental reading. Emphasis is placed upon reading with comprehension. Students are encouraged to acquire a personal paperback library of books on topics which appeal to them individually. A reading room is provided stocked with magazines and newspapers. It is hoped that this exposure to reading on topics in which he has a developed interest will encourage the student to read more widely and with greater understanding.

We give the name reaction-W to our writing program, which is carried out in a laboratory-like situation divided into two parts. In the first of these the students are exposed to speakers, tapes, field experience, films, magazines, newspapers, photographs, music, or art which are chosen to stimulate ideas about which they may then wish to communicate in writing. Many of our students come from homes which have never subscribed to a magazine or newspaper, and their background of general information is very limited. We try to broaden their experiential background, which we believe seriously limits their ability to communicate. The second portion of the writing program then concentrates upon improvement of quality in writing in reaction to these stimuli. Students are given individual attention to insure that their specific weaknesses will be identified and corrected. Classes are small, and heavy use is made of teaching aids and student tutors.

The companion part of the program in communications skills is reaction-ideas, which is designed to develop the ability for critical and creative thinking. Many of our students arrive at college with a very negative self-image and severe inhibitions. In order to stimulate them to take an interest in ideas and respond to them, a great deal of emphasis is placed upon the experience of the black man in America. Every effort is made to present a well-rounded picture, while at the same time instilling in the student a higher degree of self-pride, both personal and racial. The materials used are selected to fit the needs of the students involved. There is no basic text, but several reference texts as well as newspapers, magazines, and other communication media are used. Topics are determined in large part by the students themselves, although we do try to maximize the impact on skills and attitudes which must be developed. Some of the topics which might be used to stimulate ideas are: language as a tool, alienation, the black cultural tradition, the new morality, prejudice, and the new generation. The mentor does little or no lecturing in this program. He does ask questions which are designed to help students to discover answers for themselves. The basic assumption is that interaction between students and with the mentor promotes learning. All students are encouraged to participate. It is our policy to respect the opinions of each individual whether or not we agree with them. We feel and try to communicate the idea that everyone has something which he can and should contribute. The intellectual skills stressed and expanded in this work include knowledge, comprehension, application, analysis, synthesis, and evaluation. We try to strengthen positive attitudes such as receptiveness to new information, beliefs and attitudes and their critical self-examination, and willingness to question or challenge.

Finally, there is a speaking and listening program designed to demonstrate to the student the importance of verbal and auditory communication skills, and to develop his proficiency in these areas. The use of standard English is a subject of some controversy on our campuses. We encourage our students in the use of their own brand of English, but point out to them that communication with the world at large requires the understanding and skillful use of standard English. We try to maintain the notion that standard American English is a second and esthetically inferior (compared to the students' present dialect) language which it is necessary to master in order to provide communication with the wider English-speaking community. Some of our students have demanded foreign language credit for this type of work. This is an issue which as yet is unresolved.

The speaking and listening lab is operated more on a basis of experiencing and using language than in lecturing or theorizing about it. It is almost completely student-oriented to the extent of leaving discipline and the detailed planning of the course as much as possible to the initiative of the students. The teacher is supposed to act as a stimulus and academic consultant, and to encourage self-evaluation. He is expected to reject the role of authority except to the extent that his professional competence leads the students to confer that on him. The lack of disciplinary egulations and encouragement of the students to drop their inhibitions means that the teaching area is quite uninhibited. This helps to reach the students, helps them to think and act for themselves, and eventually develops a sense of group responsibility. The first few weeks of work tend to be chaotic, because the teacher acts only to stimulate free and leaderless discussion. Eventually the students recognize that in the absence of teacher control, it is necessary for some order to be imposed in order to make progress. Sometimes there is a tendency for the stronger student personalities to take over and become bosses, but usually the group can be led to organize on a more democratic basis. Word games, gesture games, and listening games are used to draw attention to and encourage self-evaluation of volume, speed, articulation and so on. Some time is devoted to role playing, impromptu brief talks, or radio skits. A language laboratory is available for individual remedial work on specific deficiencies.

The most successful element in this program has been the development of the students' responsibility by encouraging them to make their own decisions on classroom procedure. This has kept student interest and initiative consistently at a high pitch. It has contributed to the development of leadership, and enhanced the students' sense of personal dignity and self-determination. Physical arrangements of the classroom are also designed to encourage these results. An informal atmosphere is provided by drapes, a carpet, and lounge furniture. Students are encouraged to decorate the walls with their own work.

Other aspects of the student environment are manipulated to encourage development of communications skills. For example, all students and their tutors watch a national television newscast for thirty minutes each weekday. At its conclusion, each tutor takes his group of six to eight students aside for a discussion of the newscast they have just seen. The discussions are designed to reinforce the learning laboratories by introducing new ideas and establishing a broader base of understanding of the outside world, to increase the students' comfort with the outside world by making them more knowledgeable about it, to enhance their critical thinking abilities, and to promote group discussion. A variety of newscasts are followed, and occasionally local individuals in the news are brought to campus to speak directly to the students. Additional contacts with new ideas and the outside world are provided by visits to museums or to community agencies, attendance at concerts, recreational field trips, participation in student government, and discussions with civic and governmental leaders.

An essential factor in successful operation of a program of this type is the availability of properly trained tutors. These individuals must be able to keep the discussion on the track while appearing to leave control in the hands of the students. They must judge how far to penetrate into peripheral matters which interest the students, how to relate news items to the students' own lives, and how to conclude a good discussion while it is still exciting. They must learn to guide through asking questions which gradually become more sophisticated and probing through the course. Ultimately, the tutors should relinguish leadership of the group to its members, while acting only as resource persons themselves. The tutors are more advanced students chosen from the regular student body at that college. We have used twelve on each campus. They are given intensive training in the necessary techniques by the project director before the program begins in the fall.

Faculty training must be directed to helping them to cope with the great informality of our program. Normal barriers in the classroom are erased; this helps the students to drop their inhibitions and to begin to express themselves. Teachers who cannot cope with this situation must be eased out of the program and shifted to regular teaching.

REMEDIAL MATHEMATICS IN THE CEAP PROGRAM

Mattie T. Grigsby

The most important cause of low achievement by our students is lack of motivation, which is in turn based upon the poor self-image that culturally-disadvantaged students have of themselves. The most effective way to raise a student's self-image is to place him in a learning situation in which he can achieve success in a high status subject such as mathematics. Because mathematics is abstract, performance in it is little affected by the negative self-image of the culturally disadvantaged. They realize that our program gives them that second chance that they might not have had. Usually they have been denied college admission and CEAP accepts them despite low high school grades and low SAT scores.

The objectives of the CEAP mathematics program are communicated to our students in the form of program guidelines during their first class. The program is designed to eliminate some of their misconceptions about mathematics, and to familiarize them with some aspects of the new math. We try to make them proficient in the fundamental operations of arithmetic. We want them to become familiar with and comfortable with the use of symbols, and we hope that they will gain the confidence required to handle standardized tests successfully.

We try to familiarize them with the nature and the role of hypothesis formulation in an effort to stimulate interest in discovery of basic principles of mathematics through their own initiative. Every effort is put forth to make a student succeed. We ask that he begin his study with an open mind, and there are no prerequisites for the course other than a willingness to come to class. By discovery, lecture, small groups, individual instruction, visual and audio aids and games we try to enlist the interest and develop the mathematical abilities of the students.

Formal classes in the CEAP program meet four times each week. In addition, we provide a mathematics clinic staffed by a certified mathematics teacher. The clinic operates three hours daily, every day of the week. It is in this clinic that we try to identify and eliminate the deficiencies of individual students. All of our students are encouraged to attend the clinic, but any student who fails a unit or chapter test is required to attend until he is able to pass a make-up test which covers the same material. Special effort is devoted to developing speed and accuracy in computation in the clinic, together with the habits of checking work, neatness in work, and the ability to estimate results and to work simple mental problems. A diagnostic test is given prior to the introduction of most of our units. Performance on this test determines the multi-sensory aids which will be used by the student and the number of sessions he will devote to that unit.

No student can fail in the CEAP mathematics program. We tell him from the first class that if he earns any of the letter grades A, B, C, or D, he will earn two semester hours of credit in mathematics. He can then move on to a regular college mathematics course. Students who do not earn one of these passing grades will be given a grade of P (which means progress) or of LP (which denotes little progress). A student who earns a grade of P or LP must remain in the remedial math class for a second semester. We try to convince him that he has in any case progressed beyond his starting level, even though he has not moved on to another course. The few students in the CEAP program who cannot pass the mathematics course in two semesters are usually moved into the standard college remedial class for their third semester in order to give them one more chance to succeed.

During the CEAP summer institute for faculty, the mathematics group has compiled a handbook for our program which includes a list of objectives for each unit. We also provide samples of suggested material and an outline for each unit. New teachers who come to the CEAP program without previous experience in it are asked to read the handbook before they undertake to teach in the program. Teachers who have participated in its development do not follow it slavishly, but they do use it for reference.

AXIOMATIC MATHEMATICS AS AN INTRODUCTORY COURSE FOR THE UNDERPREPARED COLLEGE STUDENT

Hilda K. Findley

The Federal City College, which was established by Congress as the land grant college for the District of Columbia, began its third academic year in September of 1970. The college exists precariously: there has been no land grant and only a very limited authorization for capital funds, and appropriations for operation tend to be made six months or more after the fiscal year begins. Classes are held in temporary buildings widely scattered about Washington. Yet this college may well have the highest ratio of applicants to students accepted in the country: about 20 to 1. The only requirements for admission are a high school diploma and luck in the lottery. The majority of students at Federal City College (FCC) are mature, self-supporting people who work in lower-level civil service jobs. Some are nurses or small businessmen. These make up nearly all of the evening school enrollment and perhaps one-fourth of the day school students. The rest of the students are recent graduates of District of Columbia high schools or are mothers who take advantage of available day care for their children. Nearly all are black. Almost none has been exposed to a course in axiomatic mathematics. (The term axiomatic mathematics means a course which begins with a set of postulates taken as given and deduces logically from them a set of conclusions. An example of such a course is the traditional plane geometry course given in high school.)

A decision was made before the college opened that every student should have some experience with an axiomatic system and deductive logic. Since many of our students did not complete the high school algebra course, one college requirement for graduation has been set at a minimum of one math course beyond the year of axiomatic mathematics. Axiomatic algebra treats the system of arithmetic in the same way that Euclid attempted to treat the system of geometry, by stating certain principles which are to be accepted without proof, and deriving the four fundamental operations of arithmetic from them. There are four or five different ways in which the rules of arithmetic can be derived from an axiom system, depending upon which axiom set is chosen as the starting point. In all cases it is possible to derive rules for addition, subtraction, multiplication, and division and other usual operations including the rules for handling fractions. The great advantage of this is that arithmetic can then be seen as a branch of knowledge which has a form and logic instead of a bag of tricks, some of which can be applied to solving chemical problems.

A number of organizational and mechanical problems complicate efficient operation at Federal City College. Classrooms for the most part are converted offices which are not very large, and frequently more students are assigned than there are chairs in the room. The distribution of grades from the registrar's office runs as much as two quarters late, so students frequently have some difficulty in registering for the succeeding quarter. Delayed appropriations frequently result in shortages of basic materials such as paper, and there are very serious equipment shortages.

Students at FCC fall into two quite different groups. The more mature students with jobs and families are usually interested in learning about the "new math" -- they have heard about it and are usually pleasantly surprised to discover their own capacity to grasp the essentials of axiomatics. Younger students may fit into this category or any of a number of others: those who have well-defined career goals and resent being required to devote time to courses not perceived to be directly relevant to those goals, those whose primary goal is mate finding and who wish to invest minimum intellectual effort, those who want draft deferment, or those whose personal hangups prevent concentrated effort. It has been our experience at FCC that the pre-calculus mathematics program taught by a staff carefully chosen for teaching competence fails with some students in the latter categories, but succeeds in the sense that students participate in a rigorous intellectual exercise with a far higher success rate than their perparation would lead one to expect. The system is fairly open: in principle we expected to allow a student to repeat a course as many times as required to master it, with only the passing grade recorded. Staff and financial limitations have made it necessary to restrict this repeat privilege so that others can be admitted.

A very subjective view of the impact of this course on the first category of Federal City College students -- those who are older and in jobs -- is now in order. These students are for the most part mature individuals ranging from their early twenties to their fifties. They have jobs and go to school (frequently at night) in order to improve their educational backgrounds so that they can get a better civil service rating, or because they have heard somewhere along the line that a liberal education is a good thing in itself. (Perhaps it is worthwhile to point out that this is not an attitude fostered by most of the current propaganda urging young people to go to college. That tends to stress only the added income of college graduates compared to with those who do not complete college.) These individuals come to us with a great fear of arithmetic, mainly because they regard it as a bag of tricks or even a form of casting spells -- it makes that little sense to them. Therefore, the opportunity to see a coherent body of knowledge is something new and many of the students find that for the first time arithmetic begins to make sense. Our course is not oriented to problem solving, but rather presents exercises in intellectual discrimination. Students tend to be surprised to learn that they are capable of abstract thinking.

This course does not and is not intended to satisfy the mathematics prerequisite for science courses. We do not yet have a system that integrates well for science and engineering majors who began with inadequate mathematical backgrounds. Our program does not emphasize tricks that can be carried over into the chemical curriculum. Students do acquire capabilities in the program which carry over to computations, and there are striking examples of students who for the first time acquired the self-confidence to carry out independent calculations.

We have made some effort to meet the problems of the student in the scineces who must interpret a verbal statement, translate it into an algebraic expression, solve the expression and get a number from it. For this purpose, we offer a course called "Problem Solving and Mathematical Reasoning". We have no formal textbook for the course, but use Polya's "How to Solve It" as a point of departure. Enrollment in the course has been small, but people who have completed it seem to develop some skill and enthusiasm for tackling verbal problems. Many students cannot approach problems with any notion that there are straightforward procedures by which one can tackle an unknown -- simple ideas like writing down the knowns and the unknowns in order to organize the starting and ending points.

It turns out that many of the specific tools needed for computations in chemistry, for example solutions of quadratic equations, are rather unimportant in the overall scheme of mathematics. Possibly we should give up expecting all students to have mastered these before they come to us, and instead expect that a sound grounding in axiomatic mathematics will make it possible for them to be picked up quickly, or assume that they will be solved on a programmed desk calculator.

Chemists and physicists tend not to understand how difficult a mental process is required for translating a word statement into algebraic form. One reason that many students who appear unprepared on the basis of test scores finally make it through freshman chemistry is that the institutions which have learned to deal with these students (particularly the predominantly black schols) have had to learn to teach that part of mathematics which is essential to chemistry at that time. Possibly this is the best way to introduce these notions not covered in formal mathematics courses. This also eliminates the problem that mathematicians sometimes chose to illustrate problems from the basic sciences without adequate awareness of the constraints imposed by the science. For example, a mathematician might use a problem from chemical kinetics to illustrate solution of a differential equation, but without conforming to the chemical realities.

The evidence has it that over one-half of college freshmen mathematics instruction is below the calculus level. For this reason, perhaps we should not consider the courses I have described at Federal City College as remedial. Other land grant colleges also have large numbers of students who profit from instruction offered at this level, and they also have substantial minorities of middle class students who do not have job or career goals or who go to college to kill time or get married or avoid the draft. The student population at Federal City comes from lower on the economic scale but comes for the same reasons. We have chosen to respond to the lack of standard preparation in mathematics of our students by instruction in abstract algebra which is intellectually challenging rather than computationally demanding. Possibly it is a program which would be useful in a broader context.

A COMPENSATORY COURSE IN SCIENCE BACKGROUND

Ralph M. Deal

During the academic year 1969-70 I spent a sabbatical leave at the University of Illinois at Chicago Circle in order to explore the uses of educational technology in solving problems of compensatory education. The initial work was restricted to applications of computer-assisted instruction. At the December, 1969, meeting of AAAS I learned about a course plan described by Professor Fred Keller which is now in use in a variety of disciplines, including a physics course. Major characteristics of the Keller plan are

1. a fixed sequence of instructional units.
2. a student proceeds at his own pace through a unit.
3. immediate examination after the student completes a unit, by a proctor who is a paid, more advanced student. The exam is graded immediately, and the student has an opportunity to defend his answers with the proctor. The requirement to move on to the next unit is perfect performance on the examination covering the preceding unit. (This is not an altogether satisfactory criterion in our experience.)
4. lectures, demonstrations, and discussions used as motivational vehicles.
5. instructional modules furnished to the student in written form.

Proctors play a vital role in this scheme: they are in direct contact with the students in a ratio of about one proctor per ten students. The scheme has been applied to courses of 1000 students under a single faculty member assisted by student proctors. Proctors selected from students who have previously completed the course are invited to participate by the staff and are paid in academic credit rather than cash. Experience in a course in psychology conducted this way showed much larger increases in graduate record examination scores by student proctors than by students who did not proctor. Proctoring also confers status on those who are selected to do it.

For purposes of a remedial science course which must be tailored to the needs of individual students, we prefer to use a diagnostic test as the basis for assignment of a sequence of instructional units for each student. In the spring of 1970 Barry Clemson and I developed a skills hierarchy based upon the AAAS skills hierarchy used in "Science, a Process Approach". This seemed a very logical basis upon which to diagnose students' problems and skill deficiencies, and to devise a sequence in which to remedy the deficiencies. We made heavy instructional use of a series of programs in high school level mathematics written by Dr. Michael R. Eraut at Chicago Circle in 1967.* These programs contain a pretest battery to determine the point of student entry to the program. The program then branches him to drill units in those areas in which test results indicate deficiencies. The student then takes a pretest for the specific unit, and proceeds to the appropriate section of the book to work through the instructional unit. The lessons are on a frame programmed learning basis. We have found that students frequently make errors on the pretest which involve a skill not related to the unit topic. Consequently we usually went over the pretest with the student in order to convince ourselves that the deficiencies really were related to that instructional unit. Incidentally, we find that students who display deficiencies of the type which the Eraut program is designed to remedy will often not succeed when these programs are administered on a wholly self-instructional basis. Lack of self-confidence and failure to recognize the amount of effort necessary both contribute to inability to use these programs in the self-instructional mode for which they were designed. Frequently students won't play the game by the rules: for example, they fail to write down their own answers before checking the printed answer. We found it necessary to keep after them. Students do appear to become convinced of the usefulness of the program and apply it properly, after working through their first units. We feel that any self-instructional scheme loses something by the absence of proctors who grade tests immediately, and offer a student an opportunity to defend "wrong" answers. This appears to us to be a very important component of the Keller scheme.

The basic motivation for starting this course was inability of a significant number of entering students to perform at a level on the mathematics component of the chemistry placement exam which would predict success in the lowest-level chemistry course given at Chicago Circle. However, we do not think of the remedial course as a pre-chemistry course; instead we consider it a general preparation for all quantitative disciplines. Our initial version of the course strongly emphasized individual instructional units and specific skills. The general emphasis was on the cognitive domain.

In the summer, a second version of the course used teams of three or four students as well as individual work units. The teams worked out very well. They worked as a unit on assignments involving the behavior of a model drag racer. This could either be studied directly in the laboratory or (more rapidly) through a computer simulation. The dragster simulation was a seven-parameter system capable of flipping, burning out the engine, tire slipping or stalling, and it offered a printout of elapsed time for a quarter-mile race together with the final velocity obtained. The drag racer was intended to be a quantitative experience chosen in order to be real to the students in the course. (In this respect it proved better for the men than for the women.) The team was first given various exploratory or problem-oriented tasks to carry out on the model. Members then developed graphs and the corresponding equations to describe behavior of the slot car or the computer simulation of it under various conditions of electric motor voltage and wheel loading. Finally, they were asked to use their experimental data to predict behavior of the model under still other conditions. Group enthusiasm generally was high throughout this work. There was some difficulty with group domination by the more aggressive individual students, but we believe that use of the group was one of the stronger features of our course. In addition to the Eraut mathematics programs and the laboratory work with the dragster, we used a number of CAI programs for drill on specific skills such as metric units or estimation of lengths in centimeters. We also offered a weekly seminar designed to introduce new problem-solving tools and also to develop the students' ability to solve problems and to communicate.

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*Michael R. Eraut, "Programed Mathematics Review," McGraw-Hill Book Company, New York, 1967.

We found that our students are much more comfortable if they can go for help to another student who has nothing to do with assignment of grades. These students do not open up easily: they fear college and even more fear science, including chemistry. We tried to allow our students to work alone as much as possible, but when they ran into a problem we hoped they would come to us. If they did not and we saw that they were in trouble, we would go to them. Much of the work of the course was unscheduled, but the student groups were expected to come in at prearranged times. Student proctors were on hand approximately twenty-five hours per week, and a faculty member for another fifteen to twenty hours. We did not assign academic credit for the work of our proctors because they already are well along in major programs. In other courses, if we used proctors immediately out of a course of this type, we believe they would learn enough about the subject matter to deserve academic credit. They also would learn a lot about teaching.

Our current list of course goals for this course is:

1. The student should come to regard himself as capable of doing well in science courses.

2. The student should experience science as a process.

3. Students should be able to apply problem-solving methods to all problems he encounters, not only those in academic situations.

4. Students should master certain fundamental skills, methods, and concepts basic to the study of science.

THE PROGRAM OF ISE AND ITS EFFECT ON CHEMISTRY INSTRUCTION AT JACKSON STATE COLLEGE

A. H. Brown

The program of the Institute for Services to Education was started on the campus of Jackson State College in the fall of 1967. The ISE program requires the full time of enrolled students during the freshman year, and half time during the sophomore year. The physical science course is given during the first quarter of the sophomore year. Our qualitative observation is that the ISE students are better prepared for organic chemistry or advanced inorganic chemistry (either of which may follow the general chemistry in our curriculum) than are members of the student control group or our chemistry majors from a conventional introductory course. Students who have completed the ISE program in general have earned better grades than those in our student control group. Our evaluation of the advantages conferred by the ISE program indicates that these students are more open-minded than the regular student body, they do more independent thinking, they are more inquisitive, and they are more inclined to demand proof of statements.

On our campus a member of the chemistry department was assigned to teach the ISE physical science. Because he is a chemist, and because we are interested in recruiting chemists, we have tended to emphasize material from chemistry while we teach students in the ISE program by the methods worked out by ISE. The program has had considerable effect on the teaching techniques of other members of the chemistry department, who have been impressed by results in the ISE program. We feel that the department is changing rapidly and in a favorable direction as a result of this contact.

We have changed our approach to laboratory work for all courses in the chemistry department as a result of the ISE program. We've abandoned set experiments with fill-in-the-slot answers. Students now do open-ended experiments and write up their results in their own way. Whatever the results are, we expect them to be summarized and turned in. The emphasis is on the students' observations, and not on producing neat reports which contain what the teachers are thought to want. The ISE program has strengthened the chemistry department immensely through these changes in laboratory work, through incorporation of some of the ISE teaching methods in our other courses, and through recruitment of ISE students into the chemistry major.

We still are not certain about the final form of the program for a chemistry major who begins with the ISE program. We give him credit for one quarter of chemistry for taking the physical science course offered by ISE. We have designed a two-quarter course in general chemistry to follow this through the remainder of the sophomore year. This course follows the same format as the ISE program. A student begins his junior year with a need to take organic chemistry, physical chemistry, and any course such as instrumental analysis which follows physical chemistry. We hope that we can reduce the overall length of the chemistry sequence by offering organic chemistry together with a combined calculus-physical chemistry during the junior year. We plan to try teaching calculus as an integral part of the physical chemistry course. This has the advantage that it gives the calculus much more immediacy for the chemistry majors, and possibly it has the advantage of a more realistic evaluation of the importance of calculus for working chemists. We find that in many cases our students are overtrained in mathematics in the sense that they use much less than they have been given in college.

The significance of this is that the presence of the ISE program on our campus is leading to a re-examination of the entire chemistry major. We are not yet certain that we can get students through a conventional major in four school years if they begin with the ISE program. On the other hand, we are certain that we can modify the conventional major in a way which will shorten it appreciably and at the same time produce graduates who will function effectively in the chemical industry. This seems to us much more important than meeting the letter of the requirements stated by the Committee on Professional Training.

I might mention that the initial reaction of our chemistry department to the ISE program was unfavorable. This was largely because we were furnishing a faculty member from our department to teach for the ISE program, and we were furnishing laboratory space for students in it to use. At the same time, the original ISE physical science course contained essentially no chemistry, so we felt the chemistry department was being exploited to teach the material. All of this gave us a very unfavorable impression of the ISE program. However, we introduced some units from chemistry into the material we taught at Jackson State, and furthermore we found the program an excellent recruiting device for chemistry majors. These advantages have changed our opinion of the program.

The ISE program is a growing and developing program. Faculty members who attend the ISE summer institute are encouraged to develop new materials in chemistry or other fields in the context of the ISE goal to develop the students' understanding of the philosophy and nature of science. Flexibility is an important characteristic of the ISE program, and the crux of the program is its method rather than specific content.

Contact with the ISE program, particularly with laboratory work, has moved members of the chemistry department away from a traditional view of chemistry and in the direction of using ISE methods in courses for the major. Faculty members are affected by teaching technology. They've become interested in the computer, the chemical balance, or other teaching devices, and through these devices are let to investigate the teaching methods of the ISE program and adopt them in other courses.

THE CHEMISTRY PROGRAM AT FISK UNIVERSITY

Samuel von Winbush

The reaction of black students to an instructor or to a course in chemistry is related to the nature of the institution and to problems of establishing black identity in it. There are widely established (almost traditional) ways to deal with the performance of students who encounter difficulty:

1. Throw them into competition with the highly selected regular student body.

2. Ignore the need for remedial efforts.

3. Ignore the need to develop faculty empathy for the students.

4. Fail students who perform below standard.

We have tried at Fisk to avoid these faults in the operation of programs at many established institutions. Despite efforts to be selective, Fisk actually admits students with a wide range of educational backgrounds. For example, some students have already studied calculus, while others still have problems with arithmetic. In general, the deficiencies of our students are not unique because they are black; they are quite similar to the deficiencies in other categories of students who have academic problems. They appear to me to include deficiencies in verbal and language skills (reading with speed and comprehension, writing expressively and meaningfully), deficiencies in skills in arithmetic and simple algebra, and generally narrow intellectual backgrounds. We believe that a special pre-freshman summer program provides too short a period in which to overcome difficulties of this type.

We have tried to handle students with diverse backgrounds by separating those with obvious deficiencies from others who do not have such handicaps. This is done by a preregistration examination, review of the students' high school records, and individual interviews. Students in the better group (ten to twenty per year) immediately move into a standard introductory chemistry course. Students in the deficient group are first given remedial work in language, verbal and mathematical skills, and then begin a basic chemistry course conducted at a much slower rate and pitched at a more elementary level than the standard course. Students in this course range from fifty to seventy per year. We allow students to transfer between the two courses at will. This division of students into two categories has been successful in the sense that it has drastically cut our attrition rate. We have found that even our better students are deficient in their ability to gather information from outside sources and in notetaking. Help is provided by explicit attacks on these problems.

At Fisk it is assumed that ACT or SAT scores are not a useful basis for predicting success or failure of low-scoring students over the long term. Instead, we assume that students really do want to learn, but that individual rates of progress will differ. We try to postpone (by using the incomplete grade) evaluation of the slower chemistry student until he can reach his learning plateau. We operate on the assumption that acceptance of a student implies a contract to develop him to his own particular level, and we try to move each student to a point which leaves a small difference between his expectations of himself and his innate abilities. Shortly after the start of the first course in chemistry, each student is asked to write and hand in his expected grade for the course and a discussion of why he is studying it. The student is then encouraged during the period of delayed evaluation by frequent individual discussion of his expectations of himself, his current performance level and the improvements required to reach an acceptable level. A series of re-examinations is given over the same material in order to measure progress rather than to accumulate points. We try to convince the student that he will pass at a grade level satisfactory to him when he masters the stated block of material. This flexibility implies abandonment of the normal four-year standard for completion of the college program.

A modification of traditional teaching schemes is also used in this course. We feel that the traditional lecture is not the best means for either information transfer or student motivation. Teaching methods must be adjusted to the style of the individual student. To provide this flexibility, each student has an extensive syllabus which refers to appropriate reading in the text. In addition, we provide films, audio-video tapes, a mimeographed handbook, and mimeographed notes. A student comes to a scheduled class only if he has a specific problem to straighten out. He has opportunities to test himself by doing problem exercises after each work unit. The time for each unit is flexible, and is accommodated to the students' own rate of mastery of the material. A great advantage of the scheme is that it eliminates the alienation of some students by the mere presence of the instructor. It reduces the emphasis on student ability to take notes while attempting to understand what is being said in lecture.

Since many underprepared students are in that situation because of reading deficiencies, perhaps we should consider reading an inefficient way to transfer information and search for alternate methods. Possibly there is a basic difficulty with the English language because of its non-phonetic spelling. Alternatives or supplements to printed material might help substantially those students who now have difficulty in learning. We should not simply assume that we cannot communicate with a student who cannot read. As student bodies become less homogeneous, there will be increasing need to make course material available in all possible forms with the student free to select his own instructional method. If all possible methods of information transfer are available for the student to make his own selection, the student himself will judge his abilities and choose his learning style. If there is flexibility in course timing, he can do his own tracking by choosing the time he will take to complete the work. We might consider that the mismatch between disadvantaged students and the educational system is really a mismatch in communication styles. It can only be eliminated by providing many modes of communication while presenting ideas simply. In the universities, this will require a drastic change in the assignment of effort. It is traditional to teach freshmen in large sections with minimum faculty effort and to teach graduate students in small classes with maximum individual attention. If we recognize the magnitude of the educational problem we face, we must then recognize that it will be solved only by an effort of equal magnitude. It will require a rearrangement of faculty priorities to make it worthwhile and respectable to devote major effort to solving these educational problems. Much of our failure to educate underprepared students may be due to our unwillingness to make the effort necessary to develop teaching methods appropriate for them.

A COMPARISON OF GENERAL CHEMISTRY INSTRUCTION AT TWO PREDOMINANTLY BLACK INSTITUTIONS

James Pendergrast

The chemistry programs I shall discuss are at North Carolina Agricultural and Technical State University (A&T), a regional state university, and Federal City College (FCC) in Washington, D.C. FCC is the first urban land grant college in the nation. It opened in September, 1968, and has had a separate chemistry department only for one year. A&T has operated with a separate chemistry department for several decades. The teaching staff at both institutions is well trained, with a high proportion of doctorates and adequate distribution among the branches of chemistry.

The chemistry department at A&T is well housed, with separate laboratories for each course, and additional facilities for research. Facilities at FCC are meager. There is as yet no permanent campus site, and chemistry is housed in converted office space with only two laboratories which can accommodate twenty-five students at a time. Since this is the third year of operation, there will be a few majors ready to study physical chemistry. This means that general, organic, analytical, and physical chemistry will all be forced to operate in just two laboratories.

We offered two courses in general chemistry at A&T, one based upon the CPT guidelines and restricted to chemistry majors, and the other for students who planned to major in some other science for which general chemistry is a prerequisite. Total enrollment in these courses approximated three hundred students.

The general chemistry sequence for chemistry majors operated with classes smaller than twenty, used a standard high-level general chemistry text, and provided an in-depth treatment of such sophisticated topics as molecular orbital theory and coordination theory. We attribute the success of this course (success evaluated in terms of the high grades earned, and low rate of failure) to the small class size, the improved motivation of students who are in class with enthusiastic peers, and to student interest in the activities of the ACS student affiliate chapter. Upperclass members of the chapter staffed a series of student help sessions for general chemistry. The general chemistry coordinator briefed the affiliates on current materials in the majors' course and prepared them to be helpful to students who asked for it. We felt that students were somewhat more successful than faculty members in meeting the problems of students in the course. Possibly this was because students are more relaxed about discussing their deficiencies with other students. Unfortunately, it usually worked out that only the better students came to these sessions for help, and those who most needed the help did not do so. Possibly they were afraid to identify themselves and to reveal the extent of their deficiencies.

A final factor which may have contributed to the success of this majors' course was an orientation program especially designed for chemistry majors. In this one semester-hour course both students and faculty members discussed problems associated with adjustment to college life, methods of study, career opportunities in chemistry, faculty research and chemical research in general, and any classroom difficulties that students might wish to bring up.

The course for non-majors was much larger, with an enrollment between two and three hundred students. All of these are majors in fields such as biology, agriculture, engineering, or home economics for which chemistry is a requirement in their own curriculum. Many of them needed to take organic chemistry as well. This course also used a conventional text, but it was operated at a somewhat lower level with only superficial treatment of some more advanced topics. Lectures were given in a large room to the entire group at once. A great many of these students needed help with chemistry, and they were eligible to attend the sessions run by the student affiliate chapter. Very few of them did so. Consequently there was little contact with anyone who could offer individual help, and many of these students simply turned off the course during the first day in class. There was no structured scheme for providing extra help to the underprepared students.

The department of chemistry at A&T offers two major programs which lead to Bachelor of Science degree. One is a professional major, designed to prepare students either to begin careers directly, or to enter graduate school. The teaching major is designed to give students a thorough foundation in chemistry while at the same time meeting the requirements for certification as a secondary school teacher.

The chemistry program at FCC has not yet developed through the full four years of undergraduate instruction. The textbook used was the same as that at A&T, and a similar course outline was distributed. However, the level of instruction and its pace were rather lower at FCC. There were serious instructional problems which resulted from student deficiencies in reading comprehension and mathematical confidence. Possibly these were compounded by the open admissions policy at the institution. The chemistry department attempted to improve student performance by scheduling individual conferences and by encouraging students to make use of the services of the counseling and guidance center and the skills center of the institution. (The skills center is designed to provide extra help on how to study, how to type, and in remedial language and mathematics skills. It is a non-credit operation with a large and reasonably adequate staff.) We also offered tutorial sessions manned by chemistry majors and problem sessions which were supervised by teaching assistants, most of whom were graduate students at institutions such as George Washington, Howard, or American Universities. In this case also the better students took advantage of the extra help, but the majority who needed it most did not.

These courses operate in the manner which is typical of most introductory chemistry courses in most non-selective institutions in this country. These courses are presented at a level determined largely by the guidelines set by the American Chemical Society's Committee on Professional Training. These guidelines are written for conventional middle-class students in a homogeneous teaching setting. We ignore the special and much different needs of underprepared students. At the same time, the courses are operated with relatively high standards, so the attrition rate is quite high (thirty to fifty percent failures nationwide). Extra help is available but not used by those students most in need of it. We do not really reach the bulk of the students who begin a course in general chemistry, and we do not consider seriously the needs of the large majority of enrollees who are not planning to attend graduate school in chemistry.

Discussion brought out the opinion that proven methods are now known for teaching students of this type. All that is needed is the will to invest the manpower required to apply the techniques in chemistry, and the funds to offer the courses which result.

A COMPENSATORY ADAPTATION OF THE CURRICULUM OF THE ACS COMMITTEE ON PROFESSIONAL TRAINING

Harold Delaney

Morgan State College, like most predominantly black colleges, has been an inherently compensatory institution. In some instances this has resulted in development of formal programs or curricula designed to meet the needs of underprepared students. But my general impression has been that these formal programs have been less significant in helping underprepared students to bridge the gap to work at a normal college level than the informal attitudes and sensibilities of the faculties in these institutions.

The programs at Morgan State College which I will discuss were developed in the period beginning in 1948. Morgan State was founded as a private institution, and for many years received its principal support through the Methodist church. In 1938 it became a state institution and in practice the separate-but-equal institution for higher education for blacks in Maryland. In 1948 we had a department of four or five members with quite inadequate space for the influx of veterans on campus. Our sole academic criterion for admission to the college was a diploma from an accredited high school. At that time Maryland students from high schools outside the Baltimore city system were entering college with only eleven years of pre-college training. In sum, the department operated with many students whose backgrounds delayed their registration for either calculus or physical chemistry until their senior year. We had one unique feature: a department of science education which had the obligation to offer courses designed to meet the science requirement for students who majored in other areas.

In 1948 we inaugurated Martin Jenkins as President, and he set the goal that Morgan State College should develop as a competitive institution in the mainstream of higher education. In the chemistry department, this was interpreted as a need to attain approved status for the chemistry department from the Committee on Professional Training of ACS. To do so, we needed to increase the proportion of faculty members in the department who were trained through the doctorate, we had to improve facilities drastically, and we had to change our curriculum. It was clear to us that if we attained the standards of the CPT, we would then have a large number of students who could not or would not wish to meet those standards within a four-year period. Consequently, at the same time that we improved our program to meet the CPT standards, we established a preprofessional program designed to permit students who could not handle calculus or physical chemistry to graduate as chemistry majors qualified for employment at reasonable civil service levels. The preprofessional program retained the requirements of a year of quantitative analysis and one semester each of qualitative organic and qualitative inorganic analysis. Since then, one semester of the quantitative analysis has been replaced by a non-calculus physical chemistry, and the qualitative inorganic analysis has been replaced by biochemistry.

We have required all chemistry majors in either the CPT or the preprofessional curriculum to participate in a one-semester departmental seminar. Each senior presented a paper during this seminar, and the preprofessional students could see the level at which full professional majors could handle topics in chemistry, and at the same time gain the valuable experience of giving an oral presentation of a chemical topic.

During the period when these changes were occurring in the chemistry department, Morgan State College also developed a compensatory education program for all students who need it. This is primarily a freshman program, and students are assigned to it on the basis of results on tests administered at the beginning of the freshmen year. Results of these examinations determine assignment of a student to one of these categories: a group prepared to handle a rather rigorous traditional liberal arts program (this would imply ability to take a conventional introductory chemistry, physics or biology course in the freshmen year), a middle-curriculum group who seem to have a high probability of success if they can make a somewhat slower start, and finally a very substantial group (now as large as sixty percent of each entering class) whose scores indicate probable failure in the normal program at Morgan State without some special compensatory effort. Students in this last group are required to take a reduced load of twelve semester hours or less. The English course for these students meets five days each week, and is intended to provide necessary remediation and at the same time complete the normal freshman English requirement. This course is given on the basis that there could be no failure during the students' first exposure to it. Grades are either ABC or U (unsatisfactory) in the first round. The grade of U does not lower the students' academic average. On a second or later round, the students are graded ABC or E, and the failure then does appear on the record. Students in the compensatory program also study a remedial math course. Finally, each student in the program is personally known to one of our counselors. Counselors have no responsibility for academic counseling, but they are available for any sort of non-academic problem, and the personal problems brought in by these students are absolutely fantastic. I believe that the counseling program was the most important single ingredient in the success of our compensatory program.

I believe that the compensatory program has had a considerable influence on our chemistry majors. Counselors participate in all decisions on academic discipline for students, and their knowledge of individual student problems is an essential influence on correct decisions. The number of chemistry majors in the professional CPT courses has increased since the preprofessional chemistry program and the compensatory programs were started. Some students who begin in the compensatory program are able to eventually transfer to the CPT program, although they require extra time to finish. The existence of two programs gives every student who begins general chemistry the feeling that he has an option. He has not put all of his eggs in one basket, and could follow either the preprofessional program or the CPT program as his knowledge of his own abilities develops with more experience. Students with weaker backgrounds are not forced to give up their choice of chemistry for a career; they still could complete the preprofessional program and function successfully as research assistants. Majors in the CPT curriculum have a fallback option, and we have observed no serious handicaps from the fact that they have shared classes with the preprofessional students for the first 2 1/2 years.

Most of this program is now some twenty years old, and no doubt it could be strengthened significantly by exploiting the newer technological developments in education.

INTRODUCTORY CHEMISTRY AT A MAJOR URBAN UNIVERSITY

Herbert K. Livingston

Wayne State University is one of the three state-supported Michigan universities, with its own board of governors and legislatively-approved budget. Enrollment is about 35,000, and the percentage of black students is approximately the same as their percentage in the national population. No other major university has as many black students as Wayne State. Wayne State University generally has one of the ten largest groups of graduating chemistry majors. We probably have the smallest freshman chemistry classes in this group of the ten most productive departments because we teach very few service students. We have no agricultural or engineering programs. Thus we probably come fairly close to offering freshman chemistry to classes made up of chemistry majors.

Over 90 percent of all Wayne State undergraduates attended high school in Wayne County or the two adjacent counties that together make up the metropolitan area of Detroit. The high school course taught to these students is almost always the Chem Study course. Wayne State chemistry professors work with the staffs of community colleges in the three-county area to take advantage of this homogeneous background of our students and to correlate the teaching of freshman and sophomore college courses. Incoming students take a placement exam; those who fail spend three months on a course designed for students who have had no high school chemistry. After this course, or directly by placement, the student is accepted for either a six-month terminal course or for the normal freshman chemistry sequence which leads to more advanced courses. Questions on our placement examination are all on chemistry. We also give a mathematics placement test to students who wish to take freshman chemistry. These results do not correlate well with the chemistry placement scores. Students who score well on the mathematics test generally earn higher scores in freshman chemistry on the average, but students who score low in mathematics but high in chemistry can almost always complete the introductory chemistry course with a passing grade.

My personal belief is that algebra is not the portion of mathematics that should be used to judge a student's aptitude for work in chemistry, although it is conventionally used for this purpose. What is more interesting (at least for students who could become majors) is the ability to grasp symmetry concepts quickly. In terms of high school grades, geometry is probably a better predictor of performance in chemistry than is algebra. We need students who like linear algebra, matrices, and solid geometry. I have observed that non-science majors with this kind of perception come into their own when they get a little way into the chemistry program.

Of some 5000 freshmen admitted each year to Wayne State, all but 350 met the entrance requirement for 2.75 or better graduation averages from high school. These 350 are members of a special project designed to serve the needs of well-motivated Detroit students with marginal academic backgrounds. Few Project 350 students study chemistry, and we make no progress in efforts to teach them mathematics. Probably eighty percent of these students eventually major in the social science or social service areas. If a student is capable of learning one year of high school chemistry in a period of a few months, we can handle him, for we teach that material in a few months. We still have problems with the student who is not yet ready for high school chemistry when he enters, but the option remains open to him when he is prepared for it. Some of the two-year colleges offer remedial courses for which college-level credit is offered. They are designed to produce high school equivalency training, and they introduce the problem that students ask why they should study harder college-level courses if they can get college credit for courses at the high school level. We have no program of this type at Wayne State. We appear to do a reasonably good job with the Project 350 students in English, but a poor job in mathematics.

We need much greater flexibility in the undergraduate curriculum. The present rigid sequence of courses is unrealistic and inconsistent with the way students or faculty think and operate. I am surprised at the fact that while faculty members in chemistry are acutely aware of the rapid changes in their science (they tend to regard their chemical work as a treadmill on which they must run to keep up) they are willing to teach chemistry in exactly the way they were themselves taught. They think chemistry has changed, but see no need to change their own way of teaching it to students. This is true in spite of strong dedication of the faculty to teaching.

This conference has brought home to me some striking insights into faculty attitudes which I hope to bring back to our department. Attitude is much more important than technique, even though one does not want to neglect the new techniques now becoming available. Attitudes usually don't change during the lifetime of a professor, unless someone puts dynamite under him -- as now is being done! Three specific points on which faculty attitudes must change to keep pace with the times are given below.

1. We must get over the notion that the only people we can educate to expertness in the professions are those individuals who happen to think the way we do. New developments in education techniques are necessary to educate successfully this broader group, but the desire and intent to do something for them exists, and a way will be found to do it.

2. The purpose of the lecture is motivation, not information transfer. There is wide dissatisfaction with the lecture method, but probably it is destructive simply to condemn and abandon it. Lectures were in the past much more thoroughly exploited as motivational devices through the use of demonstrations. Today they are misused for the enumeration of chemical information.

3. A professor should consider that when a student matriculates in a course under him, he has entered into a contract to teach that student. The contract is meaningless unless the professor has supplied (through the course description or otherwise) a clear statement of prerequisites for the course and some screening device to verify the ability level at which he will operate the course. Once a student is in a course, there are only two valid reasons not to get him through it:

a. He is passive and fails to do his part.

b. He has misinformed the professor about his preparation.

CHEMISTRY CLINICS AT RUTGERS UNIVERSITY

Jean W. Day

The chemistry department at Rutgers, which is the state university of New Jersey, services approximately one thousand non-majors yearly in the freshman course. Many of these students plan to go on in another science or engineering. They are self-selected in the sense that they did well in high school science courses and hope to continue in science. Most of them are quite capable. However there are in the group approximately one hundred fifty students from the College of Agriculture. These students are in the course because it is required for the ag. curriculum, but the fact that they are in that curriculum doesn't mean that they have performed well in previous science courses. Thus this group of students is in the course through a process which is not self-selective in the same way that the better students have entered it. Very often they come with inferior qualification, and most of the failures in the course come from the ag. sections. Our system for scheduling quiz sections tends to separate students with different majors. Consequently, the morale in these quiz sections has been very low, and even the better students in them never try very hard. Even those students who needed help would not appear for it during office hours. Evidently they are embarrassed to ask questions, or they don't even know what questions to ask.

In 1966 the department decided that if these students would not come to us, we would go to them by offering extra help in the form of chemistry clinics. At the time of the first hour exam we passed out slips on which students who did badly could sign up for clinics if they chose. Those students who did volunteer were placed in groups of about ten with a selected experienced graduate student instructor. They met regularly for the next six weeks for extra instruction not only in the current material but also in the early material of the course. The clinics were received quite enthusiastically, and appear to have improved the performance of the students. Even those who did not attend clinics displayed improved morale and worked harder.

There appear to be several advantages in this sort of arrangement for extra help. In the first place, the student is *assigned* to a clinic. If he doesn't ask questions, the instructor begins the period with some type of work and keeps him working until questions do develop. Instructors for the clinic are graduate students selected particularly for their superior teaching abilities. We were able to give them extra salary, and in spite of wide variation in teaching style, they proved quite effective. Possibly the most important factor is that the clinics have no connection with grading. The student's instructor in a clinic assigns no grade, and is not connected with assignment of laboratory or quiz section grades by other graduate assistants.

The schedule for the clinics was designed so that they would run during the interval between the first and second hour exams of the first semester. Invitations to attend the clinics were issued immediately after the first hour exam because students frequently don't realize they need help until they have had an exam, and they are most receptive to it if they have just experienced failure. Approximately three hundred students volunteered for the clinics each year. We grouped together students who had approximately the same scores on the first hour exam. Approximately seventy-five percent of the students in the clinics attended them regularly. We conclude that chemistry clinics could be helpful in many courses in which there are students with a wide range of backgrounds. They should be held at times when students will be most receptive to extra help, and they should be kept small so that students can receive extensive individual attention.

I want now to describe briefly two other special programs at Rutgers University. Approximately one year ago, one of the buildings on the Newark campus was occupied by militant students, and this led our president to institute an open admissions policy for students who live in a community in which a campus is located. Students would then attend their local campus as day students. This open admissions program is just beginning.

Another special program is in operation at just the Rutgers College campus of the university. Several years ago we decided that we could not compete with Ivy League colleges in the scholarship offers they could make to attract qualified minority group students. It appeared that the only way we could enroll black students was to bring in high school graduates of doubtful qualifications at a pre-college level, give them extra training, and then feed them into the regular program. This program has operated at Rutgers College with approximately one hundred students per year.

Both of these programs have created some new problems for us. For one thing, if a student begins his college career by taking only remedial courses, some means must be available to decide when he can matriculate as a regular freshman. Our faculty decision was that a student who could pass three regular college courses would then be considered qualified for admission to Rutgers College. Prior to that time, his grades would not count on his grade-point average, irrespective of the number of courses he took or the number he failed. He had only to demonstrate some progress to remain in college. We modified the conventional four-year requirement for graduation, so that a student can now take between twelve and twenty credit hours per semester. In practice this means that an individual student might finish at any time period between three and five years. This is the second year of operation of the Rutgers College program, and results have been reasonably good in terms of retention of the original student group. We have as yet no adequate data on the students who entered through open admission.

A STUDENT ROOM AS A CENTER FOR REMEDIAL PROGRAMS

J. Dudley Herron

Science and engineering students at Purdue University enroll in a two-semester general chemistry course which assumes a substantial background from high school chemistry, and operates at a rather high level. The assumption that all students remember or even learn in the first place material from the high school course is false, and a significant number of students find they cannot maintain the pace and either drop out or fail. Traditional extra help sessions scheduled during evening hours were poorly attended and did not seem to offer the kind of assistance required to help students through the course. Our help lab was organized to provide more systematic assistance for students who were not prepared for the freshman course for science majors.

We prepared a set of behavioral objectives for the chemistry course. It turned out to be a very long list, with some objectives which could be strictly review of high school material, and other items which clearly represented newly-learned material. Students in the course were given this list of objectives at intervals of about two weeks. They were told that the list described the material they were expected to understand by the end of the course. They were also told that they could get additional help in the student room, and given a schedule of help lab hours. We initially kept the lab open for forty-five daytime hours per week, but at student request we have eliminated some daytime hours not heavily used, and opened the lab for about twelve hours in the evening. The lab is located in a room in the same building as the laboratories used by freshmen. It contains twenty arm chairs, together with laboratory benches which will accommodate twelve students. It has a small library which includes multiple copies of a number of programmed texts, problem books, handbooks, and mimeographed study sheets. It is staffed by graduate teaching assistants who are assigned to it as part of their teaching responsibility for the course. Five hours in the help lab are assigned as the equivalent of supervision of one three-hour laboratory. This seems a reasonable relationship since the assistant often has free time to study while he is assigned to the help lab.

The lab is equipped with multiple copies of programmed texts, such as Rundquist or Barrow, and problem books. Mimeographed study sheets are available. Three audio or tutorial program sets were prepared dealing with basic concepts, but organized around specific laboratory experiments assigned as a regular part of the course. The lab also contains visual aids such as crystal lattice models. It contains twelve laboratory stations at which students can complete regular assignments provided they come with a note from their regular laboratory instructor giving them permission for the makeup. This is to avoid encouraging students to reschedule their own laboratory periods to a more convenient hour.

Our original concept for the lab was based upon an educational technology model for instruction. We prepared study guides for each behavioral objective, and expected the students would be directed by the teaching assistant in charge of the lab to the study guide and would work independently, drawing from material in the programmed texts or audio-tutorial tapes, or the special problem sheets. A competency self-test was available, and if a student couldn't do well on that, the teaching assistant was expected to tutor him. The lab has not actually operated in that manner, for a number of reasons. Entering freshmen turn out to be rather immature, and easily delude themselves into the belief that they can get over an immediate problem and continue in good shape. They tend to resent being told that they should spend several hours going through programmed material, working additional problem assignments, or listening to audio-tutorial material. For the most part they actually come to the lab for specific help on a specific homework or laboratory problem. Furthermore, it turns out that the average teaching assistant is not sufficiently perceptive to detect the reason a student has trouble with a particular assignment, nor is he adept at selecting remedial activities which will alleviate the problem. Instead, he is likely to focus on that problem, crank out a solution which the student frequently fails to follow, and then send him on his way. Procedures are now under development which we hope will provide better diagnosis of student deficiencies and suggest appropriate remedial steps.

We try to maintain records of all students who visit the help lab. These are not very reliable, because many student visits are not recorded. Many students come only once or twice, but this does not indicate a lack of usefulness. Many of them indicated that it was quite useful for even one visit: they simply had a specific problem which was solved in one or two visits. We have some limited data which indicate that attendance at the help lab affects test scores favorably. Over fifty percent of the visits are related to specific problems which arise from laboratory experiments, and twenty-seven percent for help on specific homework problems. Students rarely come because they cannot handle specific behavioral objectives or fail to understand specific concepts. Consequently, many of the work sheets were never used.

If I were free to develop this entire course as I would like to, I would use an audio-tutorial approach throughout. In other words, the help lab would be set up so that students could go through the entire course this way, but I would not insist that no other means be provided for political reasons. The pattern for this is the biology course given by Samuel Postlethwait. He asked the question: how could I individually tutor each student in my course of four hundred students? He taped his lectures, then added worksheets, illustrations, and so forth. He now has on tape a dialogue in which he talks to students about the specimens in front of them, using worksheets, slides and film clips. He uses carefully-selected teaching assistants to tutor groups of eight students who begin their weekly sessions with the inquiry: "What did you learn about __________ this week." He gives the teaching assistants extraordinary responsibility for designing and carrying out instruction in the assembly sessions, and he believes the TA must remain with the course for some years while he gradually masters course techniques. One week of the lab is set up by each instructor, who must design and prepare the material, structure it and so on. Hence the teaching assistant becomes heavily involved with the course.

CHEMICAL TECHNOLOGY -- AN ALTERNATIVE TO PROFESSIONAL CHEMISTRY

Robert L. Pecsok

All of us in education are disturbed by what is currently happening to the "educational establishment". Our students are restless, the companies which hire our graduates are dissatisfied, and the general public which supports us is unwilling to tolerate institutions which fail to prepare students for today's world. Evidently we have been missing the mark, and some changes are in order. Chemical education has generally evolved along traditional paths with the growing amount of knowledge filtering into existing courses. Occasionally we see attempts to bridge the gaps between lecture and laboratory as well as attempts to dissolve the borders which separate the various subdivisions of chemistry. Some of these "new" curricula have gained nationwide attention and have been taught successfully, but all too often when these new courses are taught by real teachers to real students, there is little difference between the old and the new. The outcome appears to be a proliferation of texts which try to outdo one another in the amount of information sandwiched between two covers.

In courses designed primarily for the professional chemist we observe a trend to introduce unifying concepts at earlier stages, and this is good. In practice, this is achieved at the expense of time in the laboratory -- time that could be devoted to developing expertise in the practice of chemistry. There is little time for the professional chemist to become familiar -- much less expert in -- the myriad tools and techniques available to him. Instead he must rely on the laboratory specialist to conduct his experiments. In this day of specialization this is as it should be. No one can do all things even if he had the time. We call the laboratory specialist a chemical technician, and he should be an integral part of the team.

The ChemTec project is the culmination of efforts by the American Chemical Society and a number of other organizations to define the functions of a chemical technician and establish guidelines for training suitable for him. It is a development project for a curriculum to prepare chemical technicians. An original grant was made by the National Science Foundation to the American Chemical Society for the specific purpose of developing a curriculum and related textbook or other teaching aids for a two-year curriculum intended primarily for trade schools or two year colleges. In the fifteen months since the grant was made we have established a working group and defined our objectives as follows:

1. Train students in the use of common laboratory techniques.
2. Acquaint the students with the language of chemistry.
3. Teach basic chemical principles.
4. Teach some descriptive chemistry.

We had to prepare a topical list for the training program, decide upon the level and pace of presentation, and test the product to insure that it would do the job. The students to whom our texts are addressed are more interested in doing things than in developing sophisticated understanding of why things happen. We do not expect them to be expert mathematicians -- basic algebra is adequate. Formal prerequisites are less important than the desire to do careful laboratory work, for the program is necessarily highly oriented toward the laboratory. We consider that men and women who graduate from high school in the middle half of their class are prime candidates for chemical technology programs. They are not usually considered good candidates for science or engineering majors, but they tend to have higher scores for mathematical than for verbal skills. They have manipulative skills adequate to enable them to work confidently and safely in a chemical laboratory. They are more concerned with how things happen than why. Many of them would either not go to college at all, or would be unable to complete college with high grades.

We believe that the chemical technology program should focus on the laboratory, so the ChemTec books integrate laboratory and lecture work much more closely than is usual today. Experiments serve as the means leading to discussion and understanding of concepts, rather than illustrating previously discussed topics. We do the experiment first, and then ask what it showed. This leads us in a rather natural way to the introduction of appropriate concepts. We try to avoid mathematics beyond elementary algebra, and we restrict ourselves to a relatively simple vocabulary. We begin with the idea that our prospective students will not know how to read very well, and we try to orient the instruction toward the student who is not highly motivated or interested in long discussions and derivations. We have integrated the conventional areas of general chemistry, quantitative analysis, and organic chemistry in our text.

We have tried to be as imaginative as possible in selecting experiments which will be relevant to the student -- which will use materials familiar to him and at the same time serve as a source for chemical concepts. For example, our first experiment is really an examination of impure water -- some black ink which is separated into the mixture of component green and red dyes by paper chromatography. This leads the student to the notion that chemists are interested in separations and that a lot of the course will be concerned with separation methods. We point out that one must do more than just learn that ink contains a red and a green dye. What is the mixture and in what proportions? This leads to some quantitative analytical work. We move from this to a VPC separation of the components of nail polish remover or spot remover or lighter fluid or other common substances. The VPC separation and a qualitative discussion of how it works can lead to a discussion of the properties of gases.

The program is being prepared in the form of a series of short volumes each of which will be completed by the student in approximately six weeks. They will include descriptions of atomic and molecular structure, how to conduct and observe chemical reactions, and how to obtain and analyze a sample. Volumes for the second year will include more specialized treatments of modern laboratory instruments and techniques. An integral part of the curriculum will be a "Guidebook for Chemical Technicians" devoted to ancillary topics such as safety, laboratory housekeeping, notebooks, and the technician's role in the chemical industry.

Our textbooks are experimental in the true sense. They are in use this year in twelve pilot schools from which we will obtain extensive feedback from the students who use them. One instructor from each pilot school has participated in the writing project, and we expect a revision in the light of their experience.

We feel that our text might serve as a model for introductory college-level texts for badly-prepared students. It would have the same orientation and the same advantages -- it would interest students in the material before exposing them to difficult reading or mathematics. The program we are developing would not be suitable as a transfer program after two years in a junior college. This has been criticized as a dead-end street. I don't feel that it is that: there are many ways in which a person can go on if he wishes and they need not include a four year college degree. It is more important to be satisfied with one's job and aware of opportunities for continuing education offered through ACS and other organizations.

RECOMMENDATIONS

New educational techniques are available which, while unproven in this context, appear to hold promise of contributing in a major way to making higher education more broadly available to the entire college age group. We recommend that parallel attacks on the educational problems of underprepared students be promoted by sympathetic attention to proposals and by ample funding. Communication between these independent efforts should be encouraged. We believe that the following features will enhance the effectiveness of these programs:

1. Adaptability to the individual student in:

    a. starting point. This requires that adequate testing procedures be available to evaluate deficiencies.

    b. pace. Programs should be flexible enough to permit individual students to take up to six years to complete a baccalaureate degree. The initial work load particularly should be adjusted to the student's demonstrated capabilities.

    c. techniques of information transfer. The student should be able to choose among textbooks, formal lectures, films, written or computerized programmed material, self-instructional experiments, and other modes of presentation. At least some of these should emphasize non-verbal modes of communication.

    d. skills developed. Again, adequate testing must be available. Programs should be designed to encourage the insecure student by a high success rate. This is particularly necessary at the beginning stages, and might be achieved by proceeding in small steps and allowing ample time before the student is subjected to the pressures of evaluation and grading. This feature is designed to contribute to a developing positive self-image.

2. Empathy achieved by a student-oriented staff willing to step outside the conventional teacher's role.

3. Intensive individual counseling designed to deal with both academic and personal problems of the student.

4. Emphasis on broadly-based quantitative skills, rather than problem solving or narrow factual information.

5. Special attention to the ways in which needs of service students differ from those of potential chemistry majors.

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